



S. Z. S. P. Mandal's
Shri Pancham Khemraj Mahavidyalaya,
Sawantwadi-416510
(Autonomous)
Affiliated to University of Mumbai



Title of the Programme Science

B.Sc. (Zoology)

1. F.Y.B.Sc.	2024-2025
2. S.Y.B.Sc.	2025-2026
3. T.Y.B.Sc.	2026-2027

Syllabus for
Semester V
and
Semester VI

Reference: GR dated 16th May 2023 for Credit structure



University of Mumbai
S. Z.S. P. Mandal's
SHRI PANCHAM KHEMRAJ MAHAVIDYALAYA
SAWANTWADI
(An Autonomous College)
DIST: SINDHUDURG- 416 510, MAHARASHTRA
DEPARTMENT OF ZOOLOGY
Syllabus for Approval

Sr. No.	Heading	Particulars
1.	Title of the Course	T. Y. B. Sc. ZOOLOGY (MAJOR COURSE)
2.	Eligibility for Admission	SY BSc
3.	Passing Marks	40%
4.	Ordinance/Regulations (if any)	-
5.	No. of Years/Semesters	Two Semesters
6	Level	UG
7	Pattern	Semester (60:40)
8	Status	Revised
9	To be implemented from Academic Year	From Academic Year 2026-2027

Date: 08/07/2026

Signature
HoD,
Dept. of Zoology

S.Z.S.P. Mandal's
Shri Pancham Khemraj Mahavidyalaya, Sawantwadi (Autonomous)

Sr. No.	Name	Category	Designation	Signature
1	Dr. Ganesh Sambhu Margaj	12.5 (1)	HoD/Chairman	
2	Dr.Mrs.Urmila Dnyandeo Mestry	12.5 (2)	Member	
3	Dr. Mrs Shalaka Ramesh Walawalkar		Member	
4	Miss. Ravina Chandrashekhar Gawas		Member	
5	Miss. Saba Ibrahim Naik		Member	
6	Miss. Shweta Sunil Jadhav		Member	
7	Dr. Sunil. Madhukar Gaikwad		Member	
8	Dr. Manoj Maruti Ghughuskar	12.5 (3)	Member	
			Member	
9	Dr. Surekha Manoj Gupta		Member	
		12.5 (4)	Member	
			Member	
10	Dr. Narsinh L. Thakur		Member	
		12.5(5)	Member	
11	Dr. Darshana Subhash Korgaonkar	12.5 (6)	Member	
12	Mr.Mangesh Suhas Mangaonkar	12.5 (7)	Member	

Sr. No.	Headings	Particulars
1	Title of the Program	Science- Zoology
2	Eligibility	H.S.C. with Science Stream
3	Duration of the Programme	1- Certificate 2- Diploma 3- Degree 4- Degree (Hons)
4	Scheme of Examination	60 External : 40 Internal

		Separate passing in External and Internal examination
5	Standard of Passing	40.00%
6	Programme Academic Level	4.5 Certificate 5.0 Diploma 5.5 Degree 6.0 Degree (Hon.)
7	Pattern	Semester Pattern
8	Status	New
9	To Be Implemented from the academic year	4.5 Certificate 2024-2025 5.0 Diploma 2025-2026 5.5 Degree 2026-2027 6.0 Degree(Hon.) 2027-2028



S. Z. S. P. Mandal's

SHRI PANCHAM KHEMRAJ MAHAVIDYALAYA SAWANTWADI

DIST: SINDHUDURG- 416 510, MAHARASHTRA

Syllabus for Approval Programme:- T. Y. B. Sc. Major Zoology

w.e.f. Academic Year 2026-27

PREAMBLE:

S. P. K. Mahavidyalaya, Sawantwadi (Autonomous) believes in implementing several measures to bring equity, efficiency and excellence in higher education system in conformity to the guidelines laid down by the University Grants Commission (UGC). In order to achieve these goals, all efforts are made to ensure high standards of education by implementing several steps to enhance the teaching- learning process, examination and evaluation techniques and ensuring the all-round development of learners.

The four-year course in B.Sc. Zoology has been designed to have a progressive and innovative curriculum in order to equip our learners to face the future challenges in the field of education. In semester V learners are introduced to the areas of Zoology such as Taxonomy - Invertebrates and Type Study, Basic and applied Hematology, Histology and Pathology, Integumentary system and Human Osteology.

In semesters VI Taxonomy- Vertebrates and type study, Genetic Engineering and Human Genetics, Environment and Wildlife management, Bioprospecting, Zoo pharmacognosy were included in the syllabus.

The course content is made more rigorous by introducing the details of each of the above area like course are designed to help in specialization in the core areas of Zoology such as Taxonomy, Invertebrate Zoology, Hematology and Immunology, Histology, Toxicology, Biostatistics, Osteology, Chordate animals, Enzymology, Homeostasis, endocrinology, Tissue culture, Molecular biology, Genetic engineering, Wildlife management, and Zoogeography. The practical course has been designed to help the student have a firm grip on the theoretical concepts through relevant experiments in each course.

OBJECTIVES:

- To help learners in developing a scientific attitude through the Zoology curriculum that involves basic and core areas of Zoology along with the recent scientific and technological advancements in applied areas of Zoology To enhance knowledge of Zoology through tutorials and seminars
- To develop practical skills in Zoology using a range of activities such as projects in experimental Zoology, study tours, Field visits, industrial and research institutes visits.
- To inculcate a research attitude by involving learners in simple research projects review of research articles/papers, participation in scientific events etc.
- To help learners in developing analytical abilities and skills so as to address real world problems
- To help learners to plan a progressive and successful career in Zoology, education and industry.

Program Outcome: After successful completion of this programme learners will be able to

- Develop the knowledge of basic concepts of different branches of science required for postgraduate studies.
- Inculcate the skills useful in science laboratories for pursuing jobs in Industries.

- Introduce learners to the concepts useful for environment protection.
- Follow interdisciplinary approach for developing scientific temperament.
- Identify, formulate and analyze scientific problems and reach concrete solutions for societal benefits.

Program Specific Outcome: After successful completion of this programme

(Zoology) learners are able to

- Develop the knowledge of basic concepts in Zoology
- Inculcate the skills useful in Zoology laboratory.
- Introduce learners to the applied Zoology needs and concepts.
- Identify, formulate and analyze scientific problems and reach concrete solutions for societal benefits using various principles of Zoology.
- Acquire & explore essential skills to succeed in various zoology fields.
- Get a hold on higher educational opportunities like post-graduation in Zoology
- Pursue higher studies in interdisciplinary areas such as biochemistry, genetics, pathology.
- Explore research areas in Zoology and related fields.

B.Sc. (Zoology)
Credit Structure (Sem. V & VI) (B.Sc.) – Major & Minor

	R: _____ E									
Vertical		1	2	3	4	5	6			
Level	Semester	Major 1	Major 2 (Minor)	Major 3 (Minor)	OE	VSC, SEC (VSEC)	AEC, VEC, IKS	OJT, FP, CEP, CC, RP	Cum. Cr. / Sem.	Degree/ Cum. Cr.
		M1	M2	M3						
5.5	V	<u>Mandatory (10)</u> S3MJ7 Classification of Non-Chordates (2) S3MJP5 Laboratory exercises based on S3MJ7 (2) S3MJ8 Haematology and Immunology (2) S3MJP6 Laboratory exercises based on S3MJ8 (2) S3MJ9 Zoology-IKS (2)	2	----	----	VSC4a Aquaculture (2) OR VSC4b Sericulture (2) OR VSC4c Environmental Audit (2)	----	CC:2 CEP: 2	22	UG Degree 132
		<u>Elective courses (4)</u> EL1A Zoogeography and Zoopharmacognosy (2) ELP1A Laboratory exercises based on EL1A (2) OR EL1B Medical diagnostics (2) ELP1B Laboratory exercises based on EL1B (2) OR EL1C Marine Science (2) ELP1C Laboratory exercises based on EL1C (2)								

R: _____ F

		Mandatory (14) S3MJ10 Classification of Chordates (2) S3MJP7 Laboratory exercises based on S3MJ10 (2) S3MJ11 Animal Physiology (2) S3MJP8 Laboratory exercises based on S3MJ11 (2) S3MJ12: Type Study - Cuttlefish (<i>Sepia</i>) and Shark (<i>Scoliodon</i>) (2) S3MJP9 Laboratory exercises based on S3MJ12 (2) S3MJ13 Histology and Endocrinology (2)	---	---	---	---	---	OJT :4	22	
	VI	Elective courses (4) EL2A Drug development process (2) ELP2A Laboratory exercises based on EL2A (2) OR EL2B Wildlife management (2) ELP2B Laboratory exercises based on EL2B (2) OR EL2C Fishery Biology (2) ELP2C Laboratory exercises based on EL2C (2) OR EL2D Clinical research (2) ELP2D Laboratory exercises based on EL2D (2)								
	Cum Cr.	52	18	8	10	8+2+2	6+4+2	8+6+4	132	

Exit option: Award of UG Degree in Major with 132 credits OR Continue with Major

Abbreviation:

OE – Open Elective	VSC – Vocation Skill Course
SEC – Skill Enhancement Course (VSEC)	AEC – Ability Enhancement Course
VEC – Value Education Course	IKS – Indian Knowledge System

OJT – on Job Training	FP – Field Project
CEP – Community Engagement Programme	CC – Co-Curricular
RP – Research Project	

[*2 Credit IKS Major paper (Core Subject Specific Theory may be included in Sem. III or V)]

Shri Pancham Khemraj Mahavidyalaya, Sawantwadi (Autonomous)
 Proposed Third Year Curriculum as per NEP 2020
Department of Zoology
Proposed Structure for Major / Minor/OE/VSE/SEC/VEC/IKS/VEC

Semester	Paper Code		Paper Title(Unit)	Type	Credits
V (Level 4.5)	T301ZOT	I	Classification of Non chordates	Theory	2
	T302ZOT	I	Hematology and Immunology	Theory	2
	T303ZOT)	I	IKS-Zoology	Theory	2
	T304ZOP	I	Practical -I Based on Nonchordates	Practical	2
	T305ZOP	I	Practical – II Based on Haematology and Immunology	Practical	2
	T306ZOP A	I	Marine Science	Theory	2
	T306ZOP B	I	Zoogeography and Zoo Pharmangnocy	Theory	2
	T307ZOP A	I	Practical based on Marine science	Practical	2
	T307ZOP B	I	Practical based on Zoogeography and Zoo Pharmangnocy	Practical	2
	T308ZOP)	I	Environmental Audit	Practical	2
	T309ZOP)	I	CEP	Practical	2
VI			SEMESTER VI		
	S310ZOT	I	Classification of Chordate	Theory	2
	T311ZOT	I	Animal physiology	Theory	2

	T312ZOT	I	Type study Cuttlefish and Shark	Theory	2
	T313ZOT	I	Histology and Endocrinology	Theory	2
	T314ZOP		Practical I Based on Paper I and II	Practical	2
	T315ZOP		Practical II Based on paper-II and III	Practical	2
	T316ZOP		Practical III Based on paper III and IV	Practical	2
	T316ZOP		Practical III Based on paper III and IV	Practical	2
	T317ZOT A	I	Wildlife Management	Theory	2
	T317ZOT B	I	Clinical research	Theory	2
	T318ZOP A	I	Laboratory exercise based on Wildlife management	Practical	2
	T318ZOP B	I	Laboratory exercise based on Clinical research	Practical	2
	OJT	I		Practical	4

Program Structure for Sem. V & VI (NEP 2020)

Vertical No		Paper Title	Credits
Sem. V			
1.	Mandatory	1. S3MJ7: Classification of Non-Chordates	2
		2. S3MJP5: Laboratory exercises based on S3MJ7 - Classification of Non-Chordates	2
		3. S3MJ8: Haematology and Immunology	2
		4. S3MJP6: Laboratory exercises based on S3MJ8 - Haematology and Immunology	2
		5. S3MJ9: Zoology-IKS	2
	Electives	1. EL1A: Zoogeography and Zoopharmacognosy	2
		2. ELP1A: Laboratory exercises based on EL1A - Zoogeography and Zoopharmacognosy	2
		3. EL1B: Medical diagnostics	2
		4. ELP1B: Laboratory exercises based on EL1B - Medical diagnostics	2
		5. EL1C: Marine Science	2
		6. ELP1C: Laboratory exercises based on EL1C - Marine Science	2
2.	Minor (To be selected from other discipline)		4 (2+2)
4.	VSC (Practical)	1. VSC4a: Aquaculture	2
		2. VSC4b: Sericulture	2
		3. VSC4c: Environmental Audit	2
6.	CEP (To be selected from CEP topic list)		2
Credits			22
Sem. VI			
1.	Mandatory	1. S3MJ10: Classification of Chordates	2
		2. S3MJP7: Laboratory exercises based on S3MJ10 - Classification of Chordates	2
		3. S3MJ11: Animal Physiology	2
		4. S3MJP8: Laboratory exercises based on S3MJ11 - Animal Physiology	2
		5. S3MJ12: Type Study - Cuttlefish (<i>Sepia</i>) and Shark (<i>Scoliodon</i>)	2
		6. S3MJP9 Laboratory exercises based on S3MJ12 – Type Study - Cuttlefish (<i>Sepia</i>) and Shark (<i>Scoliodon</i>)	2
		7. S3MJ13: Histology and Endocrinology	2
	Electives	1. EL2A: Drug development process	2
		2. ELP2A: Laboratory exercises based on EL2A - Drug development process	2
		3. EL2B: Wildlife management	2
		4. ELP2B: Laboratory exercises based on EL2B - Wildlife management	2
		5. EL3C: Fishery Biology	2
		6. ELP3C: Laboratory exercises based on EL3C - Fishery Biology	2
		7. EL4C: Clinical research	2
		8. ELP4C: Laboratory exercises based on EL4C - Clinical research	2
2.	Minor (To be selected from other discipline)		4 (2+2)
6.	VI	OJT	4
Credits			22
Total Credits			44

Semester V
Semester V Vertical – 1 Major Mandatory

Syllabus B.Sc. (Zoology)

(Semester V)

Title of Paper: S3MJ7: Classification of Non-Chordates

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	This course offers a foundational understanding of biological classification, focusing on the identification, naming, and organization of Earth's diverse animal life. Learners will explore key concepts in taxonomy, its relation to systematics and phylogeny, gaining insight into evolutionary relationships and ecological significance. Emphasis is placed on the modern basis of classification, including the six-kingdom system, with detailed study of protists and both major and minor animal phyla.
2	Vertical:	Major
3	Type:	Theory
4	Credit:	2 credits (1 credit = 15 Hours of Theory in a semester)
5	Hours Allotted:	30 Hours
6	Marks Allotted:	50 Marks
7	Course objectives: This course acquaints learners with knowledge of, - Diverse life forms for identification, classification, and naming, which is essential for scientific communication, conservation efforts, and applications in medicine and agriculture. - Common framework to understand evolutionary relationships, ecological roles, and the economic potential of species, supporting global efforts to protect biodiversity.	
8	Course outcome: On completion of the course the learner will be able to: - Identify and classify animals. - Describe how animals evolved into the separate species.	

9	Module 1: Basis of Animal Classification, Protozoa and Kingdom Animalia I	15hrs
	1.1 Introduction to Taxonomy and studies related to it. 1.1.1 Definitions of Taxonomy, Phylogeny and Systematics and their inter-relation 1.1.2 Ranks of taxonomic classification - Kingdom, Phylum, Class, Order, Family, Genus, Species 1.1.3 Basis of Classification of living organisms 1.1.3.1 Levels of organization – Symmetry, Germ layers, Body cavity and Presence of notochord 1.1.3.2 Modern basis of classification – Molecular techniques like DNA Barcoding, Cellular Composition, Developmental Basis and Phylogenetic Basis 1.1.4 Six Kingdom Classification - General Characteristics with examples	03hrs
	1.2 Kingdom Protista – Protozoans 1.2.1 Phylum Euglenozoa or Zoomastigophora - General Characteristics and classification (with brief description of class) - Eg. <i>Euglena</i> 1.2.2 Phylum Apicomplexa or Sporozoa - General Characteristics and classification (with brief description of class) - Eg. <i>Babesia</i>, <i>Plasmodium</i> 1.2.3 Phylum Amoebozoa - General Characteristics and classification (with brief description of class) - Eg. Amoeba, <i>Chaos</i> 1.2.4 Phylum Ciliophora - General Characteristics and classification (with brief description of class) - Eg. <i>Nyctotherus</i>, <i>Paramecium</i>	04hrs
	1.3 Kingdom Animalia – Major Animal Phyla I	08hrs

	1.3.1 Phylum Porifera – General Characteristics and classification (with brief description of class), with examples 1.3.1.1 Class Calcarea (or Calcispongiae) - <i>Sycon ciliatum</i> 1.3.1.2 Class Hexactinellida (or Hyalospongiae) - <i>Hyalonema</i> spp. 1.3.1.3 Class Demospongiae - <i>Spongilla lacustris</i> 1.3.1.4 Class Homoscleromorpha - <i>Oscarella lobularis</i> (<i>Flesh sponge</i>) 1.3.2 Phylum Cnidaria – General Characteristics and classification (with brief description of class), with examples 1.3.2.1 Class Hydrozoa - <i>Physalia physalis</i> 1.3.2.2 Class Scyphozoa - <i>Cyanea arctica</i> (<i>Lions man Jellyfish</i>) 1.3.2.3 Class Anthozoa - <i>Fungia fungites</i> 1.3.2.4 Class Cubozoa - <i>Carukia barnesi</i> (<i>Box Jellyfish</i>) 1.3.3 Phylum Platyhelminthes - General Characteristics and classification (with brief description of clade) 1.3.3.1 Clade Catenulida - Eg. <i>Catenula lemnae</i> (<i>Duck weed chain Flatworm</i>) 1.3.3.2 Clade Rhabditophora - Eg. <i>Dugesia tigrina</i> 1.3.4 Phylum Nematoda - General Characteristics and classification (with brief description of class), with examples 1.3.4.1 Class Enoplea - <i>Trichuris trichiura</i> (<i>Whipworm</i>) 1.3.4.2 Class Dorylaimida - <i>Dorylaimus stagnalis</i> 1.3.4.3 Class Chromadorea - <i>Dracunculus medinensis</i>	
	Module 2: Kingdom Animalia II and minor phyla	15hrs

2.1 Kingdom Animalia – Major Animal Phyla II 2.1.1 Phylum Annelida – General Characteristics and classification (with brief description of class), with examples 2.1.1.1 Class Polychaeta - <i>Tomopteris</i> spp. 2.1.1.2 Class Oligochaeta - <i>Eisenia foetida</i> 2.1.1.3 Class Hirudinea - <i>Hirudo</i> spp. 2.1.1.4 Class Archiannelida - <i>Saccocirrus</i> spp. 2.1.2 Phylum Arthropoda - General Characteristics and classification 2.1.2.1 Subphylum Chelicerata - General Characteristics and classification – Eg. <i>Poecilotheria regalis</i> 2.1.2.2 Subphylum Crustacea - General Characteristics and classification – Eg. <i>Daphnia pulex</i> 2.1.2.3 Subphylum Hexapoda - General Characteristics and classification – Eg. <i>Musca domestica</i> 2.1.2.4 Subphylum Myriapoda - General Characteristics and classification – Eg. <i>Scutigera</i> spp. 2.1.3 Phylum Mollusca - General Characteristics and classification, with examples 2.1.3.1 Class Aplousobranchia - <i>Neomenia yamamotoi</i> 2.1.3.2 Class Monoplacophora - <i>Neopilina</i> spp. 2.1.3.3 Class Polyplacophora - <i>Squamopleura miles</i> 2.1.3.4 Class Bivalvia (Pelecypoda) - <i>Perna viridis</i> 2.1.3.5 Class Gastropoda - <i>Oxychilus draparnaudi</i> 2.1.3.6 Class Scaphopoda - <i>Dentalium burtonae</i> 2.1.3.7 Class Cephalopoda - <i>Hapalochlaena lunulata</i> 2.1.4 Phylum Echinodermata - General Characteristics and classification (with brief description of class), with examples 2.1.4.1 Subphylum Pelmatozoa – General Characteristics and classification, with examples 2.1.4.1.1 Class Crinoidea - <i>Tropiometra carinata</i> 2.1.4.2 Subphylum Eleutherozoa – General Characteristics and classification, with examples 2.1.4.2.1 Class Holothuroidea - <i>Stichopus chloronotus</i> 2.1.4.2.2 Class Echinoidea - <i>Salmacis virgulata</i> 2.1.4.2.3 Class Asteroidea - <i>Anthenea rudis</i>	12hrs
2.1.4.2.4 Class Ophiuroidea - <i>Macrophiothrix variabilis</i>	
2.2 Minor Animal Phyla 2.2.1 Phylum Hemichordata - General Characteristics and classification - Eg. <i>Saccoglossus</i> spp. 2.2.2 Phylum Onychophora - General Characteristics - Eg. <i>Typhloperipatus williamsoni</i> 2.2.3 Phylum Chaetognatha - General Characteristics with examples - Eg. <i>Aidanosagitta meenakshiae</i> 2.2.4 Phylum Tardigrada - General Characteristics with examples - Eg. <i>Stygarcus keralensis</i> 2.2.5 Phylum Brachiopoda - General Characteristics with examples - Eg. <i>Lingula anatina</i>	03hrs

10	References: 1. Zakryś, B; Milanowski, R; Karnkowska, Anna (2017). "Evolutionary Origin of Euglena". Euglena: Biochemistry, Cell and Molecular Biology. Advances in Experimental Medicine and Biology. Vol. 979. pp. 3-17. doi:10.1007/978-3-319-54910-1_1. ISBN 978-3-319-54908-8. PMID 28429314. 2. Cavalier-Smith T (1981). "Eukaryote kingdoms: seven or nine?". Bio Systems. 14 (3-4): 461-481. doi:10.1016/0303-2647(81)90050-2. PMID 7337818. 3. Euglenozoa, Encyclopedia of Life. National Museum of Natural History - Smithsonian Institution. Retrieved 16 January 2020. 4. Hodda et al. (2022) Phylum Nematoda: a classification, catalogue and index of the species, Zootaxa. 5114 (1): 1-289. 5. Francis Polkinghorne Pascoe (2023). Zoological Classification; a Handy Book of Reference with Tables of the Subkingdoms, Classes, Orders, etc., of the Animal Kingdom, Their Characters and Lists of the Families and Principal Genera, ISBN 978-1020027147. 6. Evelyn Wells (2025). Fundamentals of Animal Classification: A Beginner's Guide, ISBN-979-8313953526 7. Louis Agassiz (2023). On the Principles of Classification in the Animal Kingdom, ISBN-978-1021394712 8. Rahul Jain (2023). Kingdom Animalia Animal Classification: Quick Revision Book, ISBN-978-9358470635. 9. Kotpal, R. L. (2012). Modern text book of Zoology: Invertebrates. Rastogi Publications. 10. Verma, P. S. (2001). Invertebrate Zoology (Multicolour Edition). S. Chand Publishing.		
11	<table border="1"> <tr> <td data-bbox="167 795 829 896">Internal Continuous Assessment: 40%</td><td data-bbox="829 795 1487 896">External, Semester End Examination 60% Individual Passing in Internal and External Examination</td></tr> </table>	Internal Continuous Assessment: 40%	External, Semester End Examination 60% Individual Passing in Internal and External Examination
Internal Continuous Assessment: 40%	External, Semester End Examination 60% Individual Passing in Internal and External Examination		
12	<table border="1"> <tr> <td data-bbox="167 896 829 1030"> Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3) </td><td data-bbox="829 896 1487 1030"></td></tr> </table>	Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3)	
Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3)			

Title of Paper: S3MJP5: Laboratory exercises based on S3MJ7 – Classification of Non-Chordates

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	This Practical course provides an in-depth understanding of the levels of organization in living organisms and how these form the basis for biological classification. Learners will explore the classification of life across the six kingdoms, with a focus on animal-like Protists and members of Kingdom Animalia. The practicals include identifying, classifying, and comparing organisms from different phyla, using both structural and functional characteristics. Learners will also gain insight into the evolutionary processes that have led to the diversity of animal species today. Through detailed study and comparison, learners will develop a comprehensive understanding of biodiversity and its organization.
2	Vertical:	Major
3	Type:	Practical
4	Credit:	2 credits (1 credit = 30 Hours of Practical work in a semester)
5	Hours Allotted:	60 Hours
6	Marks Allotted:	50 Marks
7	Course objectives: This course is designed to acquaint learners to, • The levels of organization in living organism, for classifying organisms. • The six kingdoms of living organisms, reasons and the basis of their classification. • Classify and compare the animals of different phyla.	
8	Course outcome: On completion of the course the learner will be able to: • Classify organisms on the basis of the levels of organization. • Identify animalcules belonging to Kingdom Protista and animals belonging to Kingdom Animalia. • Classify and compare the animals of different phyla. • Analyse how animals evolved into the separate animal species of today's world.	
9	General Characteristics and Classification of: Kingdom Protista – Protozoans • Phylum Euglenozoa or Zoomastigophora - Eg. <i>Leishmania</i> • Phylum Apicomplexa or Sporozoa - Eg. <i>Plasmodium</i> • Phylum Amoebozoa - Eg. <i>Acanthamoeba</i> • Phylum Ciliophora - Eg. <i>Balantidium coli</i> Kingdom Animalia • Phylum Porifera ➤ Class Calcarea (or Calcispongiae) - <i>Clathrina rubra</i> ➤ Class Hexactinellida (or Hyalospongiae) - <i>Euplectella aspergillum</i> ➤ Class Demospongiae - <i>Cliona celata</i> ➤ Class Homoscleromorpha - <i>Plakortis edwardsi</i> Phylum Cnidaria • Class Hydrozoa - <i>Hydra</i> spp. • Class Scyphozoa - <i>Aurelia aurita</i> • Class Anthozoa - <i>Ptilosarcus gurneyi</i>	

- Class Cubozoa - *Chironex flecker*
- 4. **Phylum Platyhelminthes**
 - Clade Catenulida - *Paracatenula galateia*
 - Clade Rhabditophora - *Taenia solium*
- 5. **Phylum Nematoda**
 - Class Enoplea - *Trichinella spiralis*
 - Class Dorylaimida - *Vastnema crassicutaneum*
 - Class Chromadorea - *Enterobius* spp.
- 6. **Phylum Annelida**
 - Class Polychaeta - *Arenicola* spp.
 - Class Oligochaeta - *Lumbricus terrestris*
 - Class Hirudinea - *Pantobdella* spp.
 - Class Archiannelida - *Polygordius* spp.
- 7. **Phylum Arthropoda**
 - **Subphylum Chelicerata**
 - Class Arachnida - *Phrynichus phipsoni*
 - Class Pycnogonida - *Nymphon maculatum*
 - Class Merostomata - *Tachypleus gigas*
 - **Subphylum Crustacea**
 - Class Branchiopoda - *Artemia salina*
 - Class Remipedia - *Speleonectes lucayensis*
 - Class Cephalocarida - *Hampsonellus brasiliensis*
 - Class Maxillopoda - *Apocyclops cmfri*
 - Class Ostracoda - *Megalocypris princeps*
 - Class Malacostraca - *Macrobrachium rosenbergii*
 - **Subphylum Hexapoda**
 - Class Insecta - *Coccinella septempunctata*
 - Class Entognatha - *Isotomurus* spp.
 - **Subphylum Myriapoda**
 - Class Chilopoda - *Ethmostigmus rubripes*
 - Class Diplopoda - *Orthomorpha coarctata*
 - Class Pauropoda - *Pauropus amicus*
 - Class Symphyla - *Scolopendrellopsis* spp
- 8. **Phylum Mollusca**
 - Class Aplacophora - *Chaetoderma elegans*
 - Class Monoplacophora - *Veleropilina reticulata*
 - Class Polyplacophora - *Acanthopleura gemmata*
 - Class Bivalvia (Pelecypoda) - *Crassostrea madrasensis*
 - Class Gastropoda - *Subulina octona*
 - Class Scaphopoda - *Cadulus chuni*
 - Class Cephalopoda - *Nautilus pompilius*

9. Phylum Echinodermata

- **Subphylum Pelmatozoa**

- Class Crinoidea - *Stephanometra indica*

- **Subphylum Eleutherozoa**

- Class Holothuroidea - *Holothuria nobilis*

- Class Echinoidea - *Metalia persica*

- Class Asteroidea - *Pentaceraster regulus*

- Class Ophiuroidea - *Ophiothrix savignyi*

10. Minor Animal Phyla

- Phylum Hemichordata - *Rhabdopleura* spp.

11. Preparation of Classification Chart of Invertebrates.

12. Field visit to suitable place to identify invertebrates.

10	References: 1. Cavalier-Smith T (1981). "Eukaryote kingdoms: seven or nine?". Bio Systems. 14 (3-4): 461-481. doi:10.1016/0303-2647(81)90050-2. PMID 7337818. 2. Euglenozoa". Encyclopedia of Life. National Museum of Natural History - Smithsonian Institution. Retrieved 16 January 2020. 3. Hodda et al. (2022) Phylum Nematoda: a classification, catalogue and index of the species, Zootaxa. 5114 (1): 1-289. 4. Francis Polkinghorne Pascoe (2023). Zoological Classification; a Handy Book of Reference with Tables of the Subkingdoms, Classes, Orders, etc., of the Animal Kingdom, Their Characters and Lists of the Families and Principal Genera, ISBN 978-1020027147. 5. Evelyn Wells (2025). Fundamentals of Animal Classification: A Beginner's Guide, ISBN-979-8313953526 6. Louis Agassiz (2023). On the Principles of Classification in the Animal Kingdom, ISBN-978-1021394712 7. Rahul Jain (2023). Kingdom Animalia Animal Classification: Quick Revision Book, ISBN-978-9358470635		
11	<table border="1"> <tr> <td data-bbox="167 622 831 728">Internal Continuous Assessment: 40%</td><td data-bbox="831 622 1485 728">External, Semester End Examination 60% Individual Passing in Internal and External Examination</td></tr> </table>	Internal Continuous Assessment: 40%	External, Semester End Examination 60% Individual Passing in Internal and External Examination
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12	<table border="1"> <tr> <td data-bbox="167 728 831 860">Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3)</td><td data-bbox="831 728 1485 860"></td></tr> </table>	Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3)	
Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3)			

Title of Paper: S3MJ8: Haematology and Immunology

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	This course provides basic knowledge of Haematology and Immunology. The course offers the learners a foundational understanding of blood composition, hematopoiesis, erythropoiesis, hemostasis, and related disorders. Learners study haemoglobin structure, blood groups, coagulation mechanisms, and diagnostic techniques such as CBC interpretation, blood smear analysis, and biochemical tests. The course also introduces immunology principles, including types of immunity, immune cells and organs, antigen-antibody interactions, and immunoassays like ELISA. Emphasis is placed on clinical applications, modern molecular diagnostics, vaccination strategies, and current therapeutic advancements.
2	Vertical:	Major
3	Type:	Theory
4	Credit:	2 credits (1 credit = 15 Hours of Theory in a semester)
5	Hours Allotted:	30 Hours
6	Marks Allotted:	50 Marks
7	Course objectives:	• To familiarize learners with the foundational understanding of the composition and functions of blood, along with the physiological processes of haematopoiesis, erythropoiesis, and haemostasis. • To develop in learners a foundational understanding of immunology, enabling learners to grasp core concepts, relate them to practical applications, and appreciate their role in immune responses, disease prevention, and vaccination.
8	Course outcome: On completion of the course the learner will be able to:	• Describe the structural and functional components of blood, explain haematological processes and disorders, and interpret diagnostic reports. • Analyse the structure, function, and abnormalities of haemoglobin. • Apply immunological knowledge in clinical and diagnostic contexts while exploring vaccination strategies for effective disease prevention and control.

9	Module 1: Haematology	15hrs
	1.1 Basic Haematology, Blood Components and Functions 1.1.1 Definition, composition and functions of Blood, Blood volume regulation 1.1.2 Erythrocytes (RBCs) - Structure and function, anaemia (types and features), polycythemia, haematocrit 1.1.3 Leucocytes (WBCs) - Classification, functions, leucocytosis, leukopenia, overview of leukaemias 1.1.4 Platelets - Platelet structure, clotting factors and mechanism, haemostasis 1.1.5 Haematopoiesis - Bone marrow structure and function, hematopoietic stem cells, erythropoiesis, leucopoiesis, thrombopoiesis 1.1.6 Haemoglobin – structure and types (adult, foetal, abnormal), and Gas Transport– oxygen and CO₂, Bohr effect, chloride shift, degradation and bilirubin metabolism 1.1.7 Blood Groups and Transfusion - ABO and Rh systems, transfusion of blood components, transfusion principles (non-immunological) and other group.	08hrs
	1.2 Applied Haematology and Clinical significance of Diagnostic Techniques 1.2.1 Scope of applied haematology – clinical, microbiological, oncological and forensic haematology 1.2.2 Bone Marrow - bone marrow biopsy, stem cell therapy	07hrs

	1.2.3 Microscopic examination of blood - Symptoms and basic diagnostics: • Blood cancer (lymphoma, myeloma), • Infectious diseases (malaria, leishmaniasis), • Haemoglobinopathies (sickle cell anaemia, thalassemia) 1.2.4 Coagulopathies: Haemophilia and purpura 1.2.5 Biochemical examination of blood: • Liver function tests: AST, ALT, LDH, Alkaline phosphatase, Total and direct bilirubin • Kidney function test: Serum creatinine, Blood Urea Nitrogen (BUN) • Carbohydrate metabolism tests: Blood sugar, Glucose tolerance test, Glycosylated haemoglobin test • Other biochemical tests: Blood hormones - TSH, FSH, LH, CRP	
	Module 2: Immunology	15hrs
	2.1 Introduction to immunology 2.1.1 Definition and types of immunity – Innate vs. Adaptive, Active vs. Passive immunity 2.1.2 First - Physical and chemical barriers 2.1.3 Second - Phagocytosis, inflammation and fever	03hrs
	2.2 Cells and organs of the immune system 2.2.1 B cells, T cells, macrophages, dendritic cells, NK cells, mast cells 2.2.2 Primary lymphoid organs (bone marrow, thymus) 2.2.3 Secondary lymphoid organs (lymph nodes, spleen)	03hrs
	2.3 Antigens and antibodies 2.3.1 Antigens - Definition and properties 2.3.2 Antibody - Basic structure, function and classes (IgG, IgA, IgM, IgE, IgD) 2.3.3 Antigen presentation pathways - Endogenous and exogenous	03hrs
	2.4 Principles and applications of antigen-antibody reactions 2.4.1 General features of antigen-antibody reaction (Precipitation and agglutination) 2.4.2 Precipitation reactions - Radial and double immunodiffusion 2.4.3 Agglutination reactions - Blood typing, latex bead tests 2.4.4 Immunoassay - ELISA	03hrs
	2.5 Vaccines and vaccination 2.5.1 Introduction to vaccine and vaccination 2.5.2 Routes of vaccine administration 2.5.3 Classification of vaccines - Live attenuated, whole-killed, Subunit vaccines 2.5.4 Vaccine against human disease - BCG, Polio, Hepatitis	03hrs

10	References: Haematology 1. Hoffbrand, A.V., Moss, P.A.H., & Pettit, J.E. (2020). Essential Haematology, 8th Edition, Wiley-Blackwell. pp. 1-50, 200-280. 2. McPherson, R.A., & Pincus, M.R. (2017). Henry's Clinical Diagnosis and Management by Laboratory Methods, 23rd Edition, Elsevier. pp. 1-40, 450-500. 3. Bain, B.J. (2015). Blood Cells: A Practical Guide, 5th Edition, Wiley-Blackwell. pp. 1-35, 250-320. 4. Kumar, V., Abbas, A.K., & Aster, J.C. (2018). Robbins & Cotran Pathologic Basis of Disease, 10th Edition, Elsevier. pp. 1-50, 400-460. 5. Guyton, A.C., & Hall, J.E. (2021). Textbook of Medical Physiology, 14th Edition, Elsevier. pp. 1-60, 400-480. Immunology 1. Owen, J. A., Punt, J., Stranford, S. A., and Jones, P. P. (2018). Kuby immunology. 8th Edition, New York: WH Freeman. ISBN: 978-1-31911-4701.
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	2. Delves, P. J., Martin, S. J., Burton, D. R., and Roitt, I. M. (2017). Roitt's essential immunology. 13th Edition, John Wiley and Sons. ISBN: 978-1-11841-5771. 3. Bier, O. G., Da Silva, W. D., Götze, D., and Mota, I. (2012). Fundamentals of immunology. Springer Science and Business Media. ISBN: 978-3-64270-3935. 4. Paul, W. E. (2012). Fundamental immunology. 7th Edition, Lippincott Williams and Wilkins Publications. ISBN: 978-1-4511-1783-7. 5. Abbas, A. K., Lichtman, A. H., and Pillai, S. (2014). Cellular and molecular immunology E-Book: Cellular and molecular immunology. 8th Edition, Elsevier Health Sciences. ISBN: 978-0-323-22275-4. 6. Janis Kuby (1992). Immunology, WH Freeman. ISBN 0 7167 22577.	
11	Internal Continuous Assessment: 40%	External, Semester End Examination 60% Individual Passing in Internal and External Examination
12	Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3)	

Title of Paper: S3MJP6: Laboratory exercises based on S3MJ8 – Haematology and Immunology

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	This course offers a comprehensive introduction to Haematology and Immunology, emphasizing both theoretical concepts and practical laboratory skills. Learners study the composition and functions of blood. Practical sessions include blood cell counts, haemoglobin estimation, biochemical assays, ESR measurement, coagulation tests, blood typing, and immunological techniques such as agglutination, immunodiffusion, and immunoelectrophoresis. By blending foundational knowledge with hands-on diagnostics, the course prepares learners for biomedical and clinical applications.
2	Vertical:	Major
3	Type:	Practical
4	Credit:	2 credits (1 credit = 30 Hours of Practical work in a semester)
5	Hours Allotted:	60 Hours
6	Marks Allotted:	50 Marks
7	Course Objectives:	• To acquaint learners to the standard haematological and biochemical laboratory techniques. • To develop in learners the understanding of immunological principles through agglutination. • To enable learners to interpret clinical and diagnostic reports.
8	Course outcome: On completion of the course the learner will be able to:	• Perform and calculate routine blood and serum analyses. • Demonstrate proficiency in immunological tests and blood typing procedures. • Understand the structure and function of lymphoid organs and their role in immunity.
9	1. Enumeration of Erythrocytes - Total Count. 2. Enumeration of Leucocytes - Total Count. 3. Differential count of Leucocytes. 4. Estimation of haemoglobin by Sahli's acid haematin method. 5. Determination of serum LDH by using colorimeter / spectrophotometer. 6. Estimation of total serum / plasma proteins by Folin's method. 7. Estimation of serum / plasma total triglycerides by Phosphovanillin method. 8. Interpretation of Complete Blood Count (CBC) Report Including Modern Tests. 9. Latex agglutination test - Rheumatoid Arthritis 10. Determination of bleeding time and clotting time. 11. Haemagglutination test - Blood typing: ABO & Rh. 12. Study of histology of lymphoid organs - bone marrow, thymus, lymph node, spleen, tonsils, Peyer's patches. 13. Estimation of Blood Glucose GOD-POD method. 14. Estimation of calcium from blood serum (O-Cresolphthalein Complexone (OCPC) Method).	

10	References: Haematology 1. Turgeon, M.L. (2016). Clinical Hematology: Theory and Procedures, 6th Edition, Lippincott Williams & Wilkins. pp. 1-45, 210-280. 2. Tortora, G.J., & Derrickson, B.H. (2017). Principles of Anatomy and Physiology, 15th Edition, Wiley. pp. 1-40, 350-420. 3. Guyton, A.C., & Hall, J.E. (2021). Textbook of Medical Physiology, 14th Edition, Elsevier. pp. 1-60, 400-480. 4. Kumar, V., Abbas, A.K., & Aster, J.C. (2018). Robbins & Cotran Pathologic Basis of Disease, 10th Edition, Elsevier. pp. 1-50, 400-460. 5. Katzung, B.G., Vanderah, T.W., & Trevor, A.J. (2021). Basic & Clinical Pharmacology, 15th Edition, McGraw Hill Education. pp. 1-23, 79-96. Immunology 1. Owen, J. A., Punt, J., Stranford, S. A., & Jones, P. P. (2018). Kuby immunology. 8th Edition, New York: WH Freeman. ISBN: 978-1-31911-4701. 2. Delves, P. J., Martin, S. J., Burton, D. R., & Roitt, I. M. (2017). Roitt's essential immunology. 13th Edition, John Wiley & Sons. ISBN: 978-1-11841-5771. 3. Bier, O. G., Da Silva, W. D., Götze, D., & Mota, I. (2012). Fundamentals of immunology. Springer Science & Business Media. ISBN: 978-3-64270-3935. 4. Paul, W. E. (2012). Fundamental immunology. 7th Edition, Lippincott Williams & Wilkins Publications. ISBN: 978-1-4511-1783-7. 5. Abbas, A. K., Lichtman, A. H., & Pillai, S. (2014). Cellular and molecular immunology E-Book: Cellular and molecular immunology. 8th Edition, Elsevier Health Sciences. ISBN: 978-0-323-22275-4.		
11	<table border="1"> <tr> <td data-bbox="167 896 829 996">Internal Continuous Assessment: 40%</td> <td data-bbox="829 896 1487 996">External, Semester End Examination 60% Individual Passing in Internal and External Examination</td> </tr> </table>	Internal Continuous Assessment: 40%	External, Semester End Examination 60% Individual Passing in Internal and External Examination
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IKS (2)

Title of Paper: S3MJ9: Zoology-IKS

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	This course explores the rich Indian Knowledge System in the context of Zoology, focusing on the depiction and significance of animals in prehistoric and ancient Indian art, literature, and society. Learners will study animal representations in cave paintings and carvings from various archaeological sites across India. The course also delves into the role of animals in and early Indian civilizations. Additionally, it highlights the advanced understanding of animal husbandry, veterinary science, and medicine in ancient India, including systems like <i>Gaja Ayurveda</i> and <i>Haya Ayurveda</i> .
2	Vertical:	Major
3	Type:	Theory
4	Credit:	2 credits (1 credit = 15 Hours of Theory in a semester)
5	Hours Allotted:	30 Hours
6	Marks Allotted:	50 Marks
7	Course objectives: The course is designed to orient the learners to, - Indian Knowledge System with respect to Zoology. - Various animals of depicted in paintings and carvings of prehistoric and Ancient India. - The aspects of Animal Husbandry, Veterinary Science and Medicine of Ancient India.	
8	Course outcome: On completion of the course the learner will be able to: - Analyse and interpret the activities of prehistoric and ancient men residing in India on the basis of paintings and carvings made by them. - Comprehend Indian Knowledge System with respect to Animal Husbandry, Veterinary Science and Medicine.	

9	Module 1: Pre-historic carvings and paintings in India	15hrs
	1.1 Animal Depictions in Prehistoric Indian Art	07hrs
	1.1.1 Madhya Pradesh - Bhimbetka Rock Shelters	
	1.1.2 Uttar Pradesh - Kaimur Hills	
	1.1.3 Maharashtra –	
	- Amravati Rock paintings - Animal depictions in caves of Karla, Ajanta, Ellora and Elephanta - Geoglyphs and Petroglyphs of Konkan region	
	1.1.7 Goa - Petroglyphs	
	1.2 Animals in Ancient India	08hrs
	1.2.1 Common Domesticated Animals in Ancient India (Harappan and Post Harappan Period)	
	1.2.2 Wild Animals in Ancient India (Harappan and Post Harappan Period)	
	Module 2: Animal Husbandry, Veterinary Science and Medicine during Ancient Indian Era	15hrs
	2.1 Animal Husbandry in Ancient India	02hrs
	2.2 Animal Care and Veterinary Science in Ancient India	02hrs
	2.4 Ethno-Veterinary Medicine in Ancient India	02hrs
	2.5 Treatment for Domesticated animals of Ancient India	04hrs
	2.7.1 Elephant Medicine - <i>Gaja Ayurveda</i>	
	2.7.2 Equine Medicine - <i>Haya Ayurveda</i>	
	2.6 Snake Venom as a Valuable Medicine	02hrs

	2.7 Ayurveda: The Ancient Medical Science of India – Introduction to <i>Ashtanga Sangraha</i>	03hrs
10	References: 1. Anita Bagchi (2025). Animal Science and Plant Science in Ancient India and Her Conservation Ethics by ISBN 978-9348610652. 2. Avadhesh K. Singh and Kapil Kapoor (2005). Indian Knowledge Systems: Vol 1 and 2 by ISBN 978-8124603369. 3. A. K. Sharma (2014). History of Science in India (Animal Science) Vol.4 part 2. ISBN-10: ISBN-13: ,9381325561 978-9381325568. 4. Deepika Tiwari and Shobha Shouche (2025). Indian Knowledge System in the Context of Zoology: A Traditional and Scientific Perspective. International Journal of Scientific Research, Volume - 14 Issue - 05 May - 2025 PRINT ISSN No. 2277 - 8179 DOI: 10.36106/ijsr. 5. P. P. Joglekar and Pankaj Goyal (2020). Animal Husbandry and allied technologies in Ancient India – (From Prehistorical to Early Historical Times) – e-book published in 2020 ISBN 9788194689225 published by Infinity Foundation India. 6. Sanjeev Rastogi and Krishna Kaphle (2011). Sustainable Traditional Medicine: Taking the Inspirations from Ancient Veterinary Science, Evid Based Complement Alternat Med. Hindawi Publishing Corporation, Evidence-Based Complementary and Alternative Medicine, Volume 2011, Article ID 151435, 6 pages, doi:10.1093/ecam/nen071. 7. Ramachandra Guha (2024). Speaking with Nature: The Origins of Indian Environmentalism. ISBN-10: 936213490X, ISBN-13: 978-9362134905; Hardcover ISBN: 978-0300278538. 8. Gajasastra (1958). By Raja Serfoji II, Tanjore Saraswathi Mahal Series No. 76A.	
11	Internal Continuous Assessment: 40%	External, Semester End Examination 60% Individual Passing in Internal and External Examination
12	Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3)	

Semester V Vertical – 1 Electives

Title of Paper: EL1A Zoogeography and Zoopharmacognosy

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	This course offers a comprehensive introduction to Zoogeography and Zoopharmacognosy, exploring the distribution of animals across the globe and their self-medicating behaviours. Learners will acquire knowledge on the historical and modern theories of animal distribution, the impact of geological and ecological factors, and the significance of zoogeographic realms. In Zoopharmacognosy, the learners will study the use natural substances by animals for preventive and curative self-medication, highlighting its relevance to human medicine and conservation.
2	Vertical:	Elective
3	Type:	Theory
4	Credit:	2 credits (1 credit = 15 Hours of Theory in a semester)
5	Hours Allotted:	30 Hours
6	Marks Allotted:	50 Marks
7	Course objectives: The course aims at equipping the learners with the knowledge of, - Scientific and historical understanding of zoogeography, focusing on ecological, evolutionary, and geological factors that shape global animal distribution. - Zoogeographic realms with respect to biodiversity, endemism, and conservation relevance. - The concepts of zoopharmacognosy and explore ethological behaviours through which non-human animals engage in self-medication.	
8	Course outcome: On completion of the course the learner will be able to: - Analyze how biotic, abiotic, and historical factors influence the global distribution of animal species and biodiversity patterns. - Apply zoogeographic principles and case studies to understand evolutionary relationships and support conservation strategies. - Describe the concept of zoopharmacognosy and recognize self-medication behaviours in animals as adaptive strategies for health and survival.	

9	Module 1: Zoogeography I	15hrs
	1.1 Introduction to Biogeography, Zoogeography and Historical Development: 1.1.1 Definition, scope and importance of Zoogeography 1.1.2 Historical development: 1.1.2.1 Alexander von Humboldt (1769-1859) 1.1.2.2 Charles Darwin (1809-1882) 1.1.2.3 Alfred Russel Wallace (1823-1913)	02hr
	1.2 Factors Influencing Animal Distribution 1.2.1 Biotic Factors - Competition, predation, diseases 1.2.2 Abiotic Factors - Climate, temperature, water, soil 1.2.3 Dispersal – Migration via land, water or air; Movement of species to new habitats 1.2.4 Historical Influences - Continental drift, glaciations, land bridges	04hr
	1.3 Evolutionary Processes in Zoogeography 1.3.1 Continental Drift - Explains separated but related fauna 1.3.2 Vicariance - Populations split by barriers and evolve independently 1.3.3 Speciation - New species arise due to isolation 1.3.4 Plate Tectonics and Continental Drift - Isolation and speciation 1.3.5 Mountain Building - Acts as barriers to dispersal 1.3.6 Climate Change - Alters habitats and species ranges 1.3.7 Land Bridges - Enable temporary migration	09hrs

	1.3.8 Oceanic Barriers - Restrict dispersal of land animals	
	Module 2: Zoogeography II and Zoopharmacognosy	15hrs
	2.1 Modern Approaches in Zoogeography – GIS and molecular tools in Zoogeography	01hrs
	2.2 Zoogeographic Realms (based on recent phylogenetic and molecular data) and Specific Fauna related to the Realms and Antarctic Region	06hrs
	2.2.1 Palearctic Realm: The largest realm, covering Europe, North Africa, and North Asia – Camel, Chinese alligator 2.2.2 Nearctic Realm: North America, including most of Mexico and Greenland - Gila Monster, Pronghorn 2.2.3 Neotropical Realm: South and Central America, and the Caribbean – Sloth, Caiman 2.2.4 Afrotropical (formerly Ethiopian) Realm: Sub-Saharan Africa and the Arabian Peninsula – Gorilla, Secretary bird 2.2.5 Indomalayan or Oriental Realm: The Indian subcontinent, Southeast Asia and parts of Indonesia – Gibbon, Sumatran Rhinoceros 2.2.6 Australian Realm: Australia, New Guinea, and neighbouring islands – Kangaroo, Platypus 2.2.7 Oceanian Realm: New Zealand and various Pacific islands - Tuatara, Kiwi 2.2.8 Saha ro-Arabian Realm: North Africa and the Middle East – Striped hyena, Caracal 2.2.9 Panamanian Realm: Central and South America Transition Zone – Pygmy three-toed sloth, Harpy Eagle 2.2.10 Sino-Japanese Realm: East Asia, including Japan and eastern China – Japanese macaque, Green pheasant 2.2.11 Madagascan (Malagasy) Realm: Madagascar and surrounding islands, often separated from the Afrotropical realm due to high endemism – Ring-tailed Lemur, Fossa 2.2.12 Antarctic Conservation Biogeographic Regions (ACBRs) - Emperor penguin, Leopard seal	
	2.3 Introduction to Zoopharmacognosy 2.3.1 Definition, scope and importance of Zoopharmacognosy 2.3.2 Types of Zoopharmacognosy • Preventative • Curative 2.3.3 Self-medication in chimpanzees, mountain gorillas, rhesus macaques, Japanese macaques, baboons, lemurs	04hrs
	2.4 Self-medication in animals 2.4.1 Anti-parasites 2.4.2 Reproductive remedies 2.4.3 Fur rubbing 2.4.4 Geophagy 2.4.5 Digestion / Microbial medicine 2.4.6 Antivenom	03hrs
	2.5 Applications 2.5.1 Contribution to human medicines 2.5.2 Safe and responsible application of applied zoopharmacognosy techniques 2.5.3 Zootherapy	01hrs

10	Reference Books: 1. Umesh Bharti and Ravneet Kaur (2020). Concepts of Zoogeography and Wildlife. ISBN 978-81-945148-1-7. 2 Cox, C. Barry and Moore, P. D. (2010). Biogeography: An Ecological and Evolutionary Approach. Wiley-Blackwell. 3 Udvardy, M. D. F. (1969). Dynamic Zoogeography. Van Nostrand Reinhold. 4 https://pmc.ncbi.nlm.nih.gov/articles/PMC7356688/ 5 https://www.pnas.org/doi/10.1073/pnas.1419966111
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	6 https://carta.anthropogeny.org/moca/topics/self-medication-zoopharmacognosy 7 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4267359/ . 8 Richard Wrangham https://link.springer.com/chapter/10.1007/978-1-4899-1783-6_4 9 http://www.calmercreatures.co.uk/zoopharmacognosy-dogs/ .CostaNeto. 10 http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.940.6592andrep=rep1andtype=pdf	
11	Internal Continuous Assessment: 40%	External, Semester End Examination 60% Individual Passing in Internal and External Examination
12	Continuous Evaluation through: Quizzes, Class Tests, Presentation, Project, Role play, Creative writing, Assignment etc. (at least 3)	

Title of Paper: ELP1A Laboratory exercises based on EL1A Zoogeography and Zoopharmacognosy

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	This Practical course provides a comprehensive understanding of zoogeography as a scientific basis for studying animal distribution, biodiversity, and evolution. It explains key concepts such as endemism, and geographic patterns, with case studies. Learners will explore the unique fauna of major zoogeographic realms. The Practical course also introduces zoopharmacognosy, focusing on animal self-medication behaviours and the isolation of secondary metabolites like alkaloids and tannins.
2	Vertical:	Elective
3	Type:	Practical
4	Credit:	2 credits (1 credit = 30 Hours of Practical work in a semester)
5	Hours Allotted:	60 Hours
6	Marks Allotted:	50 Marks
7	Course objectives: The course is designed to acquaint the learners to, • Zoogeography as evidence for evolution by examining endemism, fossil records, and geographic distribution patterns across various realms. • Zoogeographic realms, their unique fauna, and significant case studies. • Principles of zoopharmacognosy, focusing on the isolation of natural compounds and behavioural adaptations of animals for self-medication.	
8	Course outcome: On completion of the course the learner will be able to: • Interpret patterns of animal distribution by applying knowledge of biotic, abiotic, and historical factors influencing zoogeography. • Compare and evaluate the fauna of different zoogeographic realms and explain how these patterns support theories of evolution and biodiversity. • Explain self-meditative behaviours in animals, with practical insights into secondary metabolite extraction and species-specific ethological adaptations.	

9	1. Locating Zoogeographic Realms and Antarctica regions on maps • Palearctic Realm • Nearctic Realm • Neotropical Realm • Afrotropical (formerly Ethiopian) Realm • Indomalayan or Oriental Realm • Australian Realm • Oceanian Realm • Saharo-Arabian Realm • Panamanian Realm • Sino-Japanese Realm • Madagascan (Malagasy) Realm • Antarctic Conservation Biogeographic Regions (ACBRs) 2. Identification of Fauna related to realms	
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- Palearctic Realm - Red Panda, Accentor, Mole Rat, European Cave Salamander
- Nearctic Realm - Coyote, Garter snake, Axolotl, Auk
- Neotropical Realm - Capybara, Blue-and-yellow macaw, Toucan, Poison dart frog
- Afrotropical (formerly Ethiopian) Realm - Chimpanzee, Ostrich, Okapi, Kudu
- Indomalayan or Oriental Realm - Orangutan, Colugo, Pygmy Slow Loris, Malayan Tapir
- Australian Realm - Quokka, Cassowary, Tasmanian devil, Dingo
- Oceanian Realm - Kakapo, Hector's Dolphin, New Caledonian giant gecko, Kagu
- Saharo-Arabian Realm - Fennec fox, Dorcas's gazelle, Nubian ibex, Rock hyrax.
- Panamanian Realm - Mantled Howler, Geoffroy's Tamarin, Common Basilisk Lizard, Margay
- Sino-Japanese Realm - Asian Black Bear, Iriomote cat, Steller's sea lion, Japanese taimen fish
- Madagascan (Malagasy) Realm - Satanic Leaf-tailed Gecko, Nano-chameleon, Panther Chameleon, Aye-aye
- Antarctic Conservation Biogeographic Regions (ACBRs) - Chinstrap Penguin, Weddell seals, Antarctic petrel, Elephant seal

3. Study of Zoopharmacognosy in bear, elephant, deer, lamb, cat, dog, bird.

10 References:

1. C. Barry Cox, Peter D. Moore and Richard J. Ladle (2016). Biogeography: An Ecological and Evolutionary Approach, ISBN 978-1118968581.
2. Umesh Bharti and Ravneet Kaur (2020). Concepts of Zoogeography and Wildlife. ISBN 978-81-945148-1-7.
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4. Ashutosh Kar (2017). Pharmacognosy and Pharmacobiotechnology. ISBN-10: 9386418339 ;ISBN-13938-978 6418333; New Age International Publishers.
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8. Joel Shurkin (2014). News Feature: Animals that self-medicate. Proc Natl Acad Sci U S A. 2014 Dec 9; 111(49):17339-41. doi: 10.1073/pnas.1419966111.
9. Caroline Ingraham (2014). How Animals Heal Themselves: Ingraham Applied Zoopharmacognosy. ISBN-10: :095248272X, ISBN-13 pages Ingraham 336 ,0952482727-978 .Trading Ltd
10. Eraldo Medeiros Costa-Neto (2012). Zoopharmacognosy, The Self-Medication Behavior of Animals. Interfaces Científicas - Saúde e Ambiente • Aracaju • V.01 • N.01 • p. 61-72 • out. 2012

11	Internal Continuous Assessment: 40%	External, Semester End Examination 60% Individual Passing in Internal and External Examination
12	Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3)	

Title of Paper: EL1B Medical Diagnostics

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	This course provides a comprehensive introduction to medical diagnostics, covering fundamental principles, classification of diagnostic methods, and the role of public health systems in delivering accessible diagnostic services in India. The course aims at imparting knowledge on body fluid analysis, CBC interpretation, urine examination, biosafety, and proper sample handling. The course also introduces the construction, working, and applications of essential diagnostic instruments—from basic tools like thermometers, pulse oximeters, and glucometers to advanced technologies such as ECG, ultrasound, CT, MRI, and PET scans. Emphasizing safety, accuracy, and emerging innovations, the course prepares learners to interpret diagnostic results and apply modern diagnostic practices in healthcare settings.
2	Vertical:	Elective
3	Type:	Theory
4	Credit:	2 credits (1 credit = 15 Hours of Theory in a semester)
5	Hours Allotted:	30 Hours
6	Marks Allotted:	50 Marks
7	Course objectives: The course aims acquainting the learners with the knowledge of,	• The role of public health systems, national health schemes, and emerging technologies in improving diagnostic services in India. • The fundamental principles and classification of medical diagnostic methods, including invasive and non-invasive techniques. • The construction, working, and uses of both basic and advanced diagnostic instruments.
8	Course outcome: On completion of the course the learner will be able to:	• Explain the role of advanced diagnostics and summarize their applications in early disease detection and healthcare innovation. • Classify diagnostic tools and interpret common test results such as CBC, urine analysis, ECG, and understand imaging reports like PET, CT or MRI. • Demonstrate the safe use of diagnostic tools and apply biosafety, sample handling, and waste disposal procedures in clinical/lab settings.

9	Module 1: Fundamentals of medical diagnostics	15hrs
	1.1 Basics of medical diagnostics	03hrs
	1.1.1 Definition and importance in disease detection and healthcare	
	1.1.2 Classification of diagnostic techniques – Invasive vs. non-invasive, Bedside vs. laboratory-based, Manual vs. automated diagnostics	
	1.1.3 Role of paramedical professionals and lab technicians	
	1.1.4 Importance of simple diagnostics equipment's at home	
	1.2 Basics of body fluid testing	06hrs
	1.2.1 Types of diagnostic fluids, Importance of biological fluids in health assessment	
	1.2.2 Blood diagnostics - Components and their functions, Complete Blood Count (CBC): parameters, significance, and interpretation,	
	1.2.3 Urine analysis – Composition, physical, chemical, and microscopic examination, Diagnostic significance in renal and systemic diseases	
	1.2.4 Other common diagnostic fluids - sputum, cerebrospinal fluid (CSF), Synovial fluid, Pleural and peritoneal fluids: collection methods, and their significance	
	1.3 Biosafety and sample handling in medical diagnostics	06hrs
	1.3.1 Personal Protective Equipment (PPE) - Gloves, masks, gowns, face shields,	

	eye protection, Correct donning (putting on) and doffing (removal) procedures, and safe handling of specimens, Use of biosafety cabinets and containment devices 1.3.2 Types of biomedical waste, Colour-coded waste segregation (red, yellow, blue, black bins), Safe disposal methods (incineration, autoclaving) 1.3.3 Disinfection and waste disposal – Difference between cleaning, disinfection, and sterilization, alcohols, bleach (sodium hypochlorite), hydrogen peroxide	
	Module 2: Diagnostic Instruments and Emerging Techniques	15hrs
	2.1 Basic diagnostic equipment's 2.1.1 Digital thermometers - Construction, working and advantages over mercury thermometers 2.1.2 Pulse oximeter – Principle, measurement of SpO₂ and pulse rate, normal values 2.1.3 Sphygmomanometers - Principle, components, Interpretation of readings 2.1.4 Glucometer and continuous glucose meter – Principle, strip types, normal fasting and postprandial ranges, advantages of continuous glucose meter over glucometer 2.1.5 Digital BP monitor – Principle, advantages over classic BP apparatus, and limitations 2.1.6 Stethoscope - Parts, uses and interpretation of results	04hrs
	2.2 Routine diagnostic equipments 2.2.2 Automatic cell counters - Principle, components, and applications 2.2.3 Bioanalyzers - Principle, components, and applications 2.2.4 ECG Machine - Principle, Electrodes placement, reading basic waveforms (P, QRS, T), applications in heart health monitoring 2.2.5 Nebulizer - Principle, working, applications in asthma and chronic obstructive pulmonary disease (COPD) 2.2.6 Portable ultrasound - Principle, components, applications in real-time imaging for pregnancy 2.2.7 Handheld X-Ray devices- Principle, components, role in fracture detection and chest imaging, safety protocols	05hrs
	2.3 Specialised High-End Diagnostic equipments 2.3.1 Principle, core components, common applications and associated risk ● CT Scan (Computed Tomography Scan) ● MRI (Magnetic Resonance Imaging) ● PET Scan (Positron Emission Tomography) ● EEG (Electroencephalogram) ● Sonography / ultrasound - 2D and 3D ● Amniocentesis - for genetic testing	06hrs

10	References 1. Fischbach, F. T., and Dunning, M. B. (2015). <i>A Manual of Laboratory and Diagnostic Tests</i>. 9th Edition, Philadelphia: Lippincott Williams and Wilkins. ISBN: 978-1-4511-9383-8. 2. Bishop, M. L., Fody, E. P., and Schoeff, L. E. (2018). <i>Clinical Chemistry: Principles, Techniques, and Correlations</i>. 8th Edition, Philadelphia: Wolters Kluwer. ISBN: 978-1-4963-8707-1. 3. Walker, H. K., Hall, W. D., and Hurst, J. W. (1990). <i>Clinical Methods: The History, Physical, and Laboratory Examinations</i>. 3rd Edition, Boston: Butterworths/Elsevier. ISBN: 978-0-409-90077-4. 4. WHO (World Health Organization)? (2020). <i>Basic Laboratory Procedures in Clinical Bacteriology</i>. 2nd Edition, Geneva: World Health Organization. ISBN: 978-92-4-154603-4. 5. McPherson, R. A., and Pincus, M. R. (2017). <i>Henry's Clinical Diagnosis and Management by Laboratory Methods</i>. 23rd Edition, Philadelphia: Elsevier. ISBN: 978-0-323-40125-3.
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11	Internal Continuous Assessment: 40%	External, Semester End Examination 60% Individual Passing in Internal and External Examination
12	Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3)	

Title of Paper: ELP1B Laboratory exercises based on EL1B Medical Diagnostics

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	This practical course provides learners with hands-on training in commonly used diagnostic tools, biomedical devices, and laboratory techniques essential for clinical and healthcare practice. Learners develop proficiency in measuring blood glucose, oxygen saturation, blood pressure, temperature, and understand basic ECG readings. The course includes practical skill for rapid diagnostic tests for infectious diseases, blood smear interpretation, use of stethoscopes and nebulizers, and demonstrations of ELISA and PCR techniques. Learners comprehend the working of high-end diagnostic instruments such as CT, MRI, PET, and automatic cell counters while interpreting clinical reports including CBC, biochemistry, and ECG. A mandatory visit or virtual tour of a NABH/NABL-accredited laboratory enhances practical understanding.
2	Vertical:	Elective
3	Type:	Practical
4	Credit:	2 credits (1 credit = 30 Hours of Practical work in a semester)
5	Hours Allotted:	60 Hours
6	Marks Allotted:	50 Marks
7	Course objectives:	- To provide learners with hands-on skills and conceptual understanding of commonly used diagnostic tools, biomedical devices, and laboratory techniques in clinical practice. - To develop the ability to interpret diagnostic test results and reports for effective application in healthcare and biomedical sciences.
8	Course outcome: On completion of the course the learner will be able to:	- Demonstrate the correct usage of diagnostic instruments and explain their working principles. - Analyse and interpret diagnostic results to identify health conditions such as infections, anaemia, and cardiovascular disorders.

9	- Measurement of blood glucose using glucometer (strip-based methods). - Measuring oxygen saturation using pulse oximeter. - Measurement of blood pressure using digital machine / Sphygmomanometers. - Measurement of temperature using clinical / digital thermometers. - Rapid test for Dengue / Malaria by using kit - Interpretation and usage. - Identification of malaria, sickle cell anaemia using blood smear method. (Readymade slides / photographs with positive results can be shown). - Qualitative Test for Glucose in urine (Benedict's Test). - Demonstration of use of stethoscope and nebulizer with help of videos. - Demonstration of ELISA technique (using kits or virtual labs). - Identification of medical devices/equipment's: CT scan, MRI, PET scan, Portable ultrasound, Bioanalyzers, Pulse oximeter, Automatic cell counter, Nebulizer, Handheld X-ray device (Working principal, components and applications). - Interpretation of diagnostic reports: - CBC - Blood biochemistry – Glucose, HbA1c, Creatinine, BUN (Blood Urea Nitrogen), Liver enzymes (ALT, AST, ALP), Cholesterol (LDL, HDL), triglycerides. - Urine Routine - Physical, Chemical and microscopic examination. - ECG (normal, bradycardia, tachycardia, arrhythmia, fibrillation).
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12. Report submission on visit to (or virtual tour of) a NABH / NABL – accredited lab or hospital / suitable diagnostic centre.

10	References
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| <ol style="list-style-type: none"> 1. Fischbach, F. T., & Dunning, M. B. (2015). A Manual of Laboratory and Diagnostic Tests. 9th Edition, Philadelphia: Lippincott Williams & Wilkins. ISBN: 978-1-4511-9383-8 2. Walker, H. K., Hall, W. D., & Hurst, J. W. (1990). Clinical Methods: The History, Physical, and Laboratory Examinations. 3rd Edition, Boston: Butterworths/Elsevier. ISBN: 978-0-409-90077-4 3. WHO (World Health Organization)? (2020). Basic Laboratory Procedures in Clinical Bacteriology. 2nd Edition, Geneva: World Health Organization. ISBN: 978-92-4-154603-4 4. McPherson, R. A., & Pincus, M. R. (2017). Henry's Clinical Diagnosis and Management by Laboratory Methods. 23rd Edition, Philadelphia: Elsevier. ISBN: 978-0-323-40125-3 5. Kramme, Rüdiger; Hoffmann, Klaus-Peter; Pozos, Robert Steven (Eds.). (2011). Springer Handbook of Medical Technology. Springer, Berlin/Heidelberg. ISBN: 978-3-540-74657-7 6. McPherson, R. A., & Pincus, M. R. (2021). Henry's Clinical Diagnosis and Management by Laboratory Methods. 24th Edition, Elsevier. ISBN: 978-0-323-67320-4 7. Chernecky, C. C., & Berger, B. J. (2013). Laboratory Tests and Diagnostic Procedures. 6th Edition, Saunders/Elsevier. ISBN: 978-1-4557-4693-4 8. Coleman, W. B., & Tsongalis, G. J. (Eds.). (2023). Diagnostic Molecular Pathology: A Guide to Applied Molecular Testing (2nd Edition). Elsevier. ISBN: 978-0-12-822824-1 |
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11	Internal Continuous Assessment: 40%
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External, Semester End Examination 60%
Individual Passing in Internal and External Examination

12	Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3)
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Title of Paper: EL1C Marine Science

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	This course provides a comprehensive, interdisciplinary introduction to marine science, integrating biology, chemistry, physics, and geology. Learners will comprehend the ocean's physical and chemical properties, develop key concepts such as seawater dynamics, marine biodiversity, and global circulation patterns. Learners will develop the ability to critically analyze complex environmental issues and apply scientific techniques to real-world scenarios.
2	Vertical:	Elective
3	Type:	Theory
4	Credit:	2 credits (1 credit = 15 Hours of Theory in a semester)
5	Hours Allotted:	30 Hours
6	Marks Allotted:	50 Marks
7	Course objectives: The course aims at acquainting learners to the,	• Marine organisms and planktons, using field and laboratory methods. • Chemical and physical properties of the ocean utilising instruments and datasets. • Role of blue carbon, blue economy and apply principles of sustainable coastal management principles.
8	Course outcome: On completion of the course the learner will be able to:	• Identify, analyze and preserve samples using standard sampling protocols. • Interpret physical-chemical interactions and link them to ecological implications. • Assess economic and social dimensions of coastal resources that balances conservation and livelihoods.

9	Module 1: The Ocean System: Environment, Ecology and Contemporary Challenges	15hrs
	1.1 The Marine Environment: Physical and Chemical Foundations	08hrs
	1.1.1 Zonation: Horizontal (Neritic, Oceanic) and Vertical (Pelagic, Benthic) zones 1.1.2 Physical Parameters: Density, Illumination, Temperature (thermocline) and Pressure 1.1.3 Chemical Parameters: Salinity, pH (including Ocean Acidification), Dissolved Gases (O ₂ and CO ₂), Oxygen Minimum Zones (OMZs), Nutrients (Nitrates, Phosphates, Silicates), Eutrophication, and Dissolved Organic Matter (DOM)	
	1.2 Life in the Sea: Ecology and Adaptations	02hrs
	1.2.1 Marine Organisms: Classification and adaptations of Plankton, Nekton, and Benthos (in inter-tidal and deep-sea environments) 1.2.2. Marine planktons - Diatoms (<i>Coscinodiscus</i> , <i>Skeletonema</i>), Dinoflagellates (<i>Ceratium</i> , <i>Noctiluca</i>), Holoplankton (Copepods, euphausiids), Meroplankton (zoea, nauplius, veliger, fish larvae) 1.2.3. Marine nekton – squid, octopus, cuttlefish, prawns, shark, manta ray, ghost sharks, sardines, mackerel, pomfret, blue whale, orca, dolphin, seal, dugong, sea turtle, sea snake. 1.2.4. Benthic organisms – sessile (coral, barnacle, sponge, oyster, tunicates), mobile (hermit crab, starfish, sea urchin, limpet, periwinkles), demersal (sole fish, rays, skates, tripod fish)	
	1.3 Contemporary Ecological Stressors	03hrs
	1.3.1 Coral Bleaching and its link to thermal stress 1.3.2 Microplastic Pollution and its impact on marine food webs	
	1.4 Blue Carbon Ecosystems (mangroves, seagrasses) and their critical role in carbon sequestration	02hr

	Module 2: Ocean in Motion: Dynamics, Technology and The Blue Economy	15hrs
	2.1 Ocean Dynamics and Climate Systems 2.1.1 Water Movements: Currents (Wind-driven, Thermohaline), Waves (including Tsunamis), and Tides 2.1.2 Climatic Phenomena: The Monsoon system, Cyclones, and the El Niño-Southern Oscillation (ENSO) 2.1.3 Climate Change Indicators: Marine Heatwaves and global Sea-Level Rise	06hrs
	2.2 Oceanographic Tools and Applications 2.2.1 Sampling Instruments: Niskin water sampler, Dredge, Petersen Grab, Corer, and Plankton nets (Typical, Hensen, Indian Ocean standard) 2.2.2 Measurement Instruments: Reversing thermometer, Current meter, Secchi disc, Echosounder, Wave recorder, and CTD 2.2.3 Modern Technology: GPS and SONAR, Remote Sensing, Autonomous Underwater Vehicles (AUVs), and Environmental DNA (eDNA)	07hrs
	2.3. Study of marine protected areas 2.3.1 Malvan Marine Sanctuary (Maharashtra) 2.3.2 Marine National Park (Gulf of Kutch) 2.3.3 Gulf of Mannar Marina National Park (Tamil Nadu) 2.3.4 Gahirmatha Marine Sanctuary (Odisha)	
	2.4 The Blue Economy: Introduction to sustainable management and the technological and environmental aspects of Deep-Sea Mining	02hrs

10	References 1. Thurman, H. V., & Trujillo, A. P. (2021). Essentials of oceanography (13th ed.). Pearson. 2. Pilson, M. E. Q. (2013). An introduction to the chemistry of the sea (2nd ed.). Cambridge University Press. 3. Garrison, T. (2009). Essentials of oceanography (5th ed.). Brooks/Cole, Cengage Learning. 4. Sverdrup, K. A., Duxbury, A. C., & Duxbury, A. B. (2004). An introduction to the world's oceans. McGraw-Hill. 5. Levinton, J. S. (2017). Marine biology: Function, biodiversity, ecology (5th ed.). Oxford University Press. 6. Moreau, A. (2023). Blue carbon ecosystems: Seagrass beds, mangroves, and carbon storage (Ocean Science and the Blue Economy, Vol. 2). 7. Pickard, G. L., & Emery, W. J. (1990). Descriptive physical oceanography: An introduction (6th ed.). Academic Press. 8. Pascher, K., Švara, V., & Jungmeier, M. (2022). Environmental DNA-Based Methods in Biodiversity Monitoring of Protected Areas: Application Range, Limitations, and Needs. Diversity, 14(6), 463. https://doi.org/10.3390/d14060463 . 9. Sawh, S. K., Merabet, S., Higazy, N., Béji, M., Sørensen, J. M., Range, P., Alqudah, A. M., & Daly Yahia, M. N. (2025). Environmental DNA Metabarcoding in Marine Ecosystems: Global Advances, Methodological Challenges, and Applications in the MENA Region. Biology, 14(11), 1467. https://doi.org/10.3390/biology14111467 . 10. Ray, M. & G. Umapathy (2022). Environmental DNA as a tool for biodiversity monitoring in aquatic ecosystems – a review. Journal of Threatened Taxa 14(5): 21102-21116. https://doi.org/10.11609/jott.7837.14.5.21102-21116 .	
11	Internal Continuous Assessment: 40%	External, Semester End Examination 60% Individual Passing in Internal and External Examination
12	Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3)	

Title of the Paper: ELP1C Laboratory exercises based on EL1C Marine Science

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	This practical course offers hands-on training in analyzing the physical, chemical, and biological parameters of the marine environment. Learners will develop skills to investigate seawater density and stratification, ocean acidification, nutrient dynamics, and eutrophication through laboratory experiments. Practical exercises include microscopic identification of plankton, microplastic extraction, and assessment of carbon storage in coastal sediments. Learners will comprehend the use basic oceanographic tools and models such as Secchi discs and thermohaline circulation models. Tidal curve plotting, analysis of real oceanographic datasets, and an intertidal field study enhance understanding of marine processes, ecosystem structure, and environmental adaptations.
2	Vertical:	Elective
3	Type:	Practical
4	Credit:	2 credits (1 credit = 30 Hours of Practical work in a semester)
5	Hours Allotted:	60 Hours
6	Marks Allotted:	50 Marks
7	Course objectives: The learners will be acquainted to,	• Practical skills in analyzing physical, chemical, and biological parameters of marine systems. • The basic oceanographic tools, data analysis, and field techniques. • Understanding of coastal and marine ecosystem structure and human impacts.
8	Course outcome: On completion of the course the learner will be able to:	• Perform standard marine environmental analyses and interpret results. • Demonstrate competence in plankton identification, microplastic analysis, and data handling. • Understand intertidal zonation patterns and apply ecological concepts to real coastal environments.
9	1. To study seawater stratification using temperature and salinity changes (demonstration only). 2. To simulate ocean acidification and study its impact (demonstration only). 3. To study and identify different types of zooplankton present in a water sample using a compound microscope – Zoea, Sagitta, Alima, Copepod, Mysis, Lucifer. 4. Identification of intertidal organisms - <i>Perna sp.</i> ; <i>Nerita sp.</i> ; <i>Crassostrea sp.</i> , <i>Onchidium sp.</i> , <i>Umbonium sp.</i> , <i>Astropecten sp.</i> , <i>Solen</i> , <i>mudskipper</i> , <i>Chaetopterus</i> . 5. Identification of marine fishes – <i>Rastrelliger kanagurta</i> , <i>Pampus argenteus</i> , <i>Parastromateus niger</i> , <i>Harpadon nehereus</i> , <i>Coilia dussumieri</i> , <i>Sardinella longiceps</i> , <i>Lepturacanthus Savala</i> , <i>Scomberomorus guttatus</i> . 6. Identification of seaweeds - <i>Caulerpa sp.</i> , <i>Ulva sp.</i> , <i>Padina sp.</i> , <i>Dictyota sp.</i> , <i>Sargassum sp.</i> , <i>Hypnea sp.</i> 7. To extract and identify microplastics present in beach sand samples using a simple density separation method. 8. Analysis of marine nutrients - Phosphates, Silicates, Nitrates and Nitrites. 9. Determination of organic carbon content in coastal sediments. 10. To measure water clarity and estimate the photic zone depth under laboratory conditions using a Secchi disc (demonstration only). 11. To study, interpret and applications of the tide table (demonstration only). 12. Calculation of marine litter abundance and beach quality indices - clean coast index, hazardous and anthropogenic beach litter index.	
	13. Field visit to study biodiversity of intertidal organisms by visiting rocky and sandy shores / Field visit to fish market / fish landing centres.	

10	References 1. Thurman, H. V., & Trujillo, A. P. (2021). <i>Essentials of oceanography</i> (13th ed.). Pearson. 2. Pilson, M. E. Q. (2013). <i>An introduction to the chemistry of the sea</i> (2nd ed.). Cambridge University Press. 3. Garrison, T. (2009). <i>Essentials of oceanography</i> (5th ed.). Brooks/Cole, Cengage Learning. 4. Sverdrup, K. A., Duxbury, A. C., & Duxbury, A. B. (2004). <i>An introduction to the world's oceans</i>. McGraw-Hill 5. Levinton, J. S. (2017). <i>Marine biology: Function, biodiversity, ecology</i> (5th ed.). Oxford University Press. 6. Moreau, A. (2023). Blue carbon ecosystems: Seagrass beds, mangroves, and carbon storage (Ocean Science and the Blue Economy, Vol. 2). 7. Pickard, G. L., & Emery, W. J. (1990). <i>Descriptive physical oceanography: An introduction</i> (6th ed.). Academic Press. 8. Pascher, K., Švara, V., & Jungmeier, M. (2022). Environmental DNA-Based Methods in Biodiversity Monitoring of Protected Areas: Application Range, Limitations, and Needs. <i>Diversity</i>, 14(6), 463. https://doi.org/10.3390/d14060463. 9. Sawh, S. K., Merabet, S., Higazy, N., Béji, M., Sørensen, J. M., Range, P., Alqudah, A. M., & Daly Yahia, M. N. (2025). Environmental DNA Metabarcoding in Marine Ecosystems: Global Advances, Methodological Challenges, and Applications in the MENA Region. <i>Biology</i>, 14(11), 1467. https://doi.org/10.3390/biology14111467. 10. Ray, M. & G. Umapathy (2022). Environmental DNA as a tool for biodiversity monitoring in aquatic ecosystems – a review. <i>Journal of Threatened Taxa</i> 14(5): 21102-21116. https://doi.org/10.11609/jott.7837.14.5.21102-21116.		
11	<table border="1"> <tr> <td data-bbox="167 891 831 994">Internal Continuous Assessment: 40%</td><td data-bbox="831 891 1487 994">External, Semester End Examination 60% Individual Passing in Internal and External Examination</td></tr> </table>	Internal Continuous Assessment: 40%	External, Semester End Examination 60% Individual Passing in Internal and External Examination
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12	<table border="1"> <tr> <td data-bbox="167 994 831 1128">Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3)</td><td data-bbox="831 994 1487 1128"></td></tr> </table>	Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3)	
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Semester-V Vertical – 4 VSC

Syllabus

B. Sc. (Zoology) (Semester V)

Title of the Paper: VSC4a Aquaculture

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	Aquaculture involves the controlled cultivation of aquatic organisms such as fish, crustaceans, molluscs, and aquatic plants. Aquaculture is one of the fastest-growing industries in India, contributing significantly to employment generation and national GDP. Economic success depends on efficient management of inputs like feed and labour in relation to market value. This vocational course is designed to equip learners with practical knowledge required to establish and manage an aquaculture farm as a profitable enterprise.
2	Vertical:	4: VSCa
3	Type:	Practical
4	Credit:	2 credits (1 credit = 30 Hours of Practical work in a semester)
5	Hours Allotted:	60 Hours
6	Marks Allotted:	50 Marks
7	Course Objectives: The course is designed to equip learners to, • Comprehensive knowledge of freshwater, marine, and brackish water aquaculture systems, including site selection, farm design, and species selection suitable for Indian conditions. • Practical skills in water and soil quality analysis, plankton identification, disease diagnosis, feed management, and biosecurity practices in aquaculture. • Aquaculture farm planning for sustainable and profitable aquaculture enterprises.	
8	Course Outcomes: Upon completion of the course, the learners should be able to: • Plan and design aquaculture farms, select suitable species, and manage water, soil, feed, and health parameters effectively. • Demonstrate the ability to identify plankton, weeds, predators, and diseases, and apply appropriate preventive and management strategies. • Evaluate economic feasibility, preparing project reports for small to medium-scale aquaculture ventures.	
9	1. Study of the criteria for the site selection, design and construction of aquaculture of fish and shell fish (cages, rafts, pens, raceways, dyke, inlet, and outlet construction). 2. Study of pond design and its types (nursery, rearing, stocking). 3. Study of various instruments and gears: Nets (drag, cast, trap), Aerators, pumps, feed dispensers, Secchi disk, pH meter, and DO meter. 4. Estimation of water parameters: Temperature, conductivity, ammonia, nitrate, phosphate, alkalinity, and hardness. 5. Estimation of soil parameters: Soil texture and pH. 6. Identification of Plankton: Identification of phytoplankton - <i>Chlorella</i>, <i>Scenedesmus</i>, <i>Navicula</i>, <i>Spirulina</i>; Identification of zooplankton: Rotifers, Cladocerans, and Copepods. 7. Study of the criteria for the selection of species for aquaculture. Identification of cultivable finfish and shellfish species: Indian Major Carps (<i>Catla</i>, <i>Rohu</i>, <i>Mrigal</i>), exotic carps (Silver Carp, Grass Carp, Common Carp), catfish (<i>Pangasius</i> spp), sea bass, mullet, freshwater prawn, tiger prawn, mud crab. 8. Diagnosis and prevention of common bacterial - Edwardsiellosis (Enteric Septicemia of Catfish), Streptococcosis, Aeromoniasis (Motile Aeromonas Septicemia); viral – Infectious Pancreatic Necrosis (IPN), Viral Hemorrhagic Septicemia (VHSV), White Spot Syndrome Virus	

	(WSSV); fungal - Fusariosis, Cladosporiosis; and parasitic diseases - Gill fluke infection, <i>Lepeophtheirus</i> infection and <i>Capillaria</i> infection. 9. Disinfection protocols used in aquaculture – Types of disinfectants, disinfection protocols, disinfection of eggs and larvae, disinfection of materials and equipment, disinfection of source water and water pipelines. 10. Study of types of fish feed (natural vs. artificial) and nutritional requirements of fishes. 11. Calculation and study of Feed Conversion Ratio (FCR), Food Efficiency Ratio (FER), Protein Efficiency Ratio (PER). 12. Live feed culture - zooplankton - <i>Artemia</i>, <i>Infusoria</i> and <i>Daphnia</i>. 13. Preparation and submission of a feasibility report for a small to medium-scale aquaculture farm. 14. Visit to a freshwater aquaculture farm to observe practices and submission of a detailed report on the same.
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10	References: 1. Jhingran, V.G. (1982). Fish and Fisheries of India. Hindustan Publishing Corporation India. 2. Chhapgar, B. F. (1991). Seashore life of India (Vol. 3). Oxford University Press. 3. Pillai, N. K. (1986). Introduction to Planktology. Himalaya Publication house Bombay. 4. Boyd, C. E. (1982). Water quality Management for Pond fish culture Elsevier Scientific Publishing Company. 5. APHA, AWWA, WPCF (1998). Standard methods for the Examination of Water and waste water, 20th ED. 6. Pillay, T.V.R. & Kutty, M. N. (2005). Aquaculture- Principles and Practices. Blackwell. 7. Rath, R. K. (2000). Freshwater Aquaculture. Scientific Publ 8. Beavea, R. (1990). Handbook of the Freshwater Fishes of India. Narendra Publ. House. India, 9. Khanna, S.S. & Singh, H.R. (2006). A Textbook of Fish Biology and Fisheries. Narendra Publ. House., India 10. Chandy, M. (1996). Fishes, National Book Trust India.	
11	Internal Continuous Assessment: 40%	External, Semester End Examination 60% Individual Passing in Internal and External Examination
12	Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3)	

Title of the Paper: VSC4b Sericulture

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	The sericulture industry provides an opportunity for economic development and also generates employment. As the environmental conditions are suitable for culturing silk worms, the orientation and vocational training in sericulture practices help in supplementary income generation in agriculture. The course introduces the basic techniques in sericulture and prepares the learners to attain skills in maintaining their own setup for sericulture.
2	Vertical:	4: VSCb
3	Type:	Practical
4	Credit:	2 credits (1 credit = 30 Hours of Practical work in a semester)
5	Hours Allotted:	60 Hours
6	Marks Allotted:	50 Marks
7	Course Objectives: The course is designed to acquaint the learners to, • Different silk worms, the stages in the life cycle, and larval instars. • Techniques in the rearing of silk worms. • Design and plan a sericulture unit.	
8	Course Outcomes: Upon completion of the course, the learners should be able to: • Identify and compare the stages of the life cycle for different species of silk moths. • Apply the rearing techniques for silk worms. • Examine different facilities and develop a plan for the sericulture unit.	
9	1. Identification of different varieties of silk moths using the external features. 2. Study of the life cycle of the silk worm - Mulberry and silk moth Tassar. 3. Study of the digestive system and silk glands- Mulberry and silk moth Tassar. 4. Identification of different larval instar stages of the silk worm -Mulberry and Tassar Silk moth. 5. Study of various host plants used in sericulture -Mulberry, Arjun, Castor, Som. 6. Identification and study of silkworm rearing appliances used in sericulture - Rearing stands and Trays, Ant wells, Chopsticks and feathers, Montages, Reeling machine. 7. Observation of hatching of silkworm eggs in the laboratory setup. 8. Demonstration of feeding as per the instars of the silkworm in a laboratory setup. 9. Study of feeding frequency, feeding time, and quantity in silk worm rearing. 10. Study of the collection and processing of cocoons. 11. Identification, study, and management of common diseases of silkworm - Grasserie, Flacherie, Pebrine, and Muscardian. 12. Identification, study, and management of common pests, predators of silk worm - Uzi fly, Ants, Dermastid beetle, and lizards. 13. Visit to a suitable sericulture unit to study the following aspects a) Mulberry cultivation area and rearing facility for silkworms b) Silk reeling, Silk weaving unit c) Grainage and Rearing unit 14. Submission of a business plan/feasibility report for a small-scale sericulture unit. The center can consider visiting the Sericulture Training Institute or organizing a workshop for learners to receive basic training with the help of experts.	

10	References: 1. Advances in Sericulture (Volume-1) (2024) by Dr. S. Susikaran, C. Kiruthika, B. K.M. Bharathi, M. A. Niranjana, K.R. Harika, and V. Vasanth Rubicon Publications 2. Sericulture- Present and Future Perfect (2023) by Dr. V. S. Shewale, Book Saga Publications 3. Handbook of Practical Sericulture" by S. R. Ullal and M N Narasimhanna, Central Silk Board, Bangalore 4. Manual on silkworm egg production by Dr. M.N. Narasimhanna, Central Silk Board, First Edi, 1988 5. A Textbook on Sericulture Rearing and Management of Silkworm (2023) by Jyoti Das I I P Iterative International Publishers 6. Sericulture and Pest Management (2002) by T. V. Sathye and A. Jadhav, Daya Publishing House 7. Moriculture Science of Mulberry Cultivation by Kichisaburo Minamizawa. Second Edition 1997 8. Handbook of Pests and Diseases of Mulberry and Silkworm (1990) by K. Sengupta, P. Kumar, M. Baig, and Govindaiah. Pub., by UNESCAP, Bangkok, Thailand. 9. Handbook of Sericulture Technologies (2003) Publisher: Central Silk Board 10. Modern Entomology by D. B. Tembhare, Second edition, Himalaya Publishing House 11. रेशीम उद्योग सचित्र माचिती पुस्तिका रेशीम संलनालय, मलराष्ट्र राज्य, नागपूर		
11	<table border="1"> <tr> <td data-bbox="209 757 804 860">Internal Continuous Assessment: 40%</td><td data-bbox="804 757 1503 860">External, Semester End Examination 60% Individual Passing in Internal and External Examination</td></tr> </table>	Internal Continuous Assessment: 40%	External, Semester End Examination 60% Individual Passing in Internal and External Examination
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Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3)			

Title of Paper: VSC4c Environmental Audit

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	This vocational course provides a comprehensive hands-on training on the methods, and applications of environmental auditing in institutional settings. Learners will gain hands-on experience in planning audit workflows, profiling environments, and monitoring key parameters such as energy use, water consumption, waste generation, biodiversity, air quality, and noise levels. The course emphasizes regulatory compliance, including Solid Waste, E-waste, and hazardous waste management rules.
2	Vertical:	4: VSCc
3	Type:	Practical
4	Credit:	2 credits (1 credit = 30 Hours of Practical work in a semester)
5	Hours Allotted:	60 Hours
6	Marks Allotted:	50 Marks
7	Course Objectives: The course is designed to acquaint learners to, • The principles, planning, and systematic execution of environmental audits in institutional settings. • Skills in data collection, analysis, and interpretation related to energy, water, waste, biodiversity, air, noise, and carbon footprint assessments. • Environmental legislation, compliance requirements, and sustainability practices for institutional environmental management.	
8	Course Outcomes: Upon completion of the course, the learners should be able to: • Design and conduct comprehensive environmental audits using standard workflows and reporting formats. • Demonstrate competence in auditing resource consumption, waste management, pollution levels, and environmental compliance. • Prepare a complete environmental audit report with actionable recommendations for sustainability and regulatory compliance.	
9	1. Environmental Audit Planning and Workflow Design – Prepare a working plan including pre-audit, on-site audit, and post-audit activities. 2. Institutional Environmental Profile – Prepare a brief profile of the selected institution covering land use, green cover, demography, and environmental policy. 3. Electricity Consumption Audit - Prepare an interpretive report on two-year electricity usage with analysis and recommendations. 4. Lighting Audit - Assess natural and artificial lighting and evaluate energy efficiency. 5. Key devices used in water consumption (Drip irrigation system and sensor operated taps), measurement (smart water meter, electromagnetic flowmeter, portable electronic ground water level meter), water management (acoustic leak detectors, pressure reducing valves). 6. Survey plant / animal diversity in the campus or any suitable area and assess its ecological importance. 7. Air Quality Monitoring and Analysis - Compile air quality data from CPCB / MPCB / suitable website / AQI device and analyze seasonal trends and interventions. 8. Coloured bins for waste segregation – containers covering solid waste, e-waste, hazardous waste and biomedical waste. 9. Social and Community Impact Assessment - A suitable case study. 10. Noise Pollution Mapping - Measure and analyze ambient noise levels in suitable area.	

	11. Study of water-saving installations - rainwater harvesting and dual-flush systems. 12. Carbon Footprint Estimation - Estimate emissions from activities like electricity use, travel, and printing. 13. Environmental Compliance Audit – Review institutional adherence to safety signage, chemical storage, and environmental housekeeping. 14. Environmental Audit Report Compilation – Compile all data, observations, and analysis into a final environmental audit report.	
10	References: 1. Rao, M.N. & Rao, H.V.N. Air Pollution Control. Tata McGraw Hill, 2005. Cunningham, W.P., Cunningham, M.A. & Saigo, B.W. Environmental Science: A Global Concern. McGraw Hill Education, Latest Edition. 3. Khopkar, S.M. Environmental Pollution Analysis. New Age International, 2004. 4. UNEP. Environmental Audit Guidelines. United Nations Environment Programme, 2018. 5. CPCB (Central Pollution Control Board) Reports & Manuals, Government of India. 6. ISO 14001 Environmental Management System - Standards and Guidelines.	
11	Internal Continuous Assessment: 40%	External, Semester End Examination 60% Individual Passing in Internal and External Examination
12	Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3)	

Semester VI

Semester VI Vertical – 1 Major Mandatory

Syllabus B.Sc. (Zoology) Semester – VI

Title of Paper: S3MJ10: Classification of Chordates

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	This course provides a comprehensive study of chordate taxonomy, covering the structural features, evolutionary relationships, and classification of major chordate groups. Beginning with Cephalochordates and Urochordates, the course illustrates vertebrate diversity from jawless and jawed fishes, amphibians, reptiles, birds, and mammals. The course illustrates representative species from each taxonomic group, describing diagnostic characters, and adaptive features. This course emphasizes on a modern, clade-based approach, providing insight into lineage diversification, evolutionary transitions, and ecological significance of each taxon. Integrating classical taxonomy with updated systematic frameworks, the course is designed to equip learners with a strong foundation in vertebrate taxonomy.
2	Vertical:	Major
3	Type:	Theory
4	Credit:	2 credits (1 credit = 15 Hours of Theory in a semester)
5	Hours Allotted:	30 Hours
6	Marks Allotted:	50 Marks
7	Course objectives: The course is designed to acquaint learners to, • The diversity, diagnostic characteristics, and phylogenetic relationships of major chordate groups using modern taxonomic frameworks. • Classification of chordates up to species level and understand evolutionary adaptations across aquatic and terrestrial lineages. • Chordate systematics by integrating morphological, ecological, and evolutionary perspectives.	
8	Course outcome: On completion of the course the learner will be able to: • Categorize chordates into major clades, classes, and orders while identifying key distinguishing features of representative species. • Understand evolutionary trends, such as transitions from invertebrate chordates to vertebrates and from aquatic to fully terrestrial vertebrates. • Interpret chordate diversity through systematic, phylogenetic, and ecological contexts.	

9	Module 1: Classification of Chordates - I	15hrs
	1.1 Overview of chordate diversity and characteristics of chordates	01hr
	1.2 Classification of Phylum Chordata	02hrs
	1.2.1 Subphylum Cephalochordata (lancelets) – <i>Branchiostoma indicum</i>	
	1.3 Clade: Olfactores	03hrs
	1.3.1 Subphylum: Tunicata or Urochordata • Class Ascidiacea (sea squirts) – <i>Herdmania momus</i> • Class Thaliacea (salps) – <i>Thalia democratica</i> • Class Larvacea or Appendicularia (appendicularians) – <i>Oikopleura</i>	
	1.4 Subphylum: Vertebrata (Craniata)	09hrs
	1.4.1 Infraphylum Cyclostomata (jawless fishes) • Class Myxini (hagfishes) – <i>Eptatretus</i> spp.	

• Class Petromyzontida (lampreys) – <i>Petromyzon marinus</i> 1.4.2 Infraphylum Gnathostomata (jawed fishes) • Class Chondrichthyes (cartilaginous fishes) ▪ Subclass Elasmobranchii (sharks, skates, and rays) – <i>Rhincodon typus</i> ▪ Subclass Holocephali (chimaeras also known as ghost sharks) – <i>Rhinochimaera pacifica</i> • Class Osteichthyes (bony fishes) ▪ Subclass Actinopterygii (ray-finned fishes) – <i>Anabas testudineus</i> ▪ Subclass Sarcopterygii (lobe-finned fishes) – <i>Latimeria chalumnae</i>	
Module 2: Classification of Chordates - II	15hrs
2.1 Clade Tetrapoda (four-limbed vertebrates) 2.1.1 Class Amphibia • Order Anura or Salientia (frogs and toads) – <i>Hoplobatrachus tigerinus</i> • Order Caudata or Urodela (salamanders and newts) – <i>Tylotriton verrucosus</i> • Order Gymnophiona or Apoda (caecilians) – <i>Ichthyophis bombayensis</i> 2.1.2 Class Reptilia • Order Crocodilia (alligators, caimans, true crocodiles and gharials) – <i>Gavialis gangeticus</i> • Order Testudines (turtles, tortoises, and terrapins) – <i>Geochelone elegans</i> • Order Squamata (lizards, snakes and worm lizards) – <i>Hemidactylous brooki</i> • Order Rhynchocephalia (tuatara) – <i>Sphenodon punctatus</i>	07hrs
2.2 Class Aves 2.2.1 Division Palaeognathae (flightless ratites) – <i>Struthio</i> spp. 2.2.2 Division Neognathae (all other modern birds) – <i>Pavo cristatus</i>, <i>Columba livia</i>	02hrs
2.3 Class Mammalia 2.3.1 Subclass Prototheria (monotremes – egg-laying mammals) – <i>Tachyglossus aculeatus</i> 2.3.2 Subclass Metatheria (marsupials – Pouch-bearing mammals) – <i>Phascogaleus cinereus</i> 2.3.3 Subclass Eutheria (placentals) – <i>Hoolock hoolock</i>, <i>Rhinoceros unicornis</i>	06hrs

10	References: 1. Noriyuki Satoh (2016). Chordate Origins and Evolution, The Molecular Evolutionary Road to Vertebrates. Academic Press is an imprint of Elsevier, Copyright © 2016 Elsevier Inc. All rights reserved. ISBN: 978-0-12-809934-6 (Print); ISBN: 978-0-12-803006-6 (Online). 2. Lindell Bromham (2016). An Introduction to Molecular Phylogenetics and evolution. Oxford University Press. ISBN 978–0–19–873636–3. 3. Vineeta Rawat (2024). Animal Taxonomy, Behaviour and Chronobiology. ISBN-13: -978 8196080655. 4. Eschmeyer's Catalog of Fishes: The website provides monthly updates and addenda to the core family-group names list. 5. Integrated Taxonomic Information System (ITIS): A highly comprehensive and authoritative source for the scientific names and classification of species globally. It is widely used as a standard ITIS (.gov). 6. IUCN Red List of Threatened Species: While primarily focused on conservation status, it uses a robust and current taxonomic framework for mammals, birds, reptiles, and amphibians IUCN Red List. 7. The Reptile Database: A continuously updated resource that provides the current taxonomy and geographic data for all known reptile species The Reptile Database.	
	8. IOC World Bird List: Maintained by the International Ornithologists' Union, this is a leading reference for the classification and nomenclature of the world's birds IOC World Bird List. 9. Mammal Diversity Database (MDD): Curated by the American Society of Mammalogists, this database reflects the most current understanding of mammal taxonomy ASM Mammal Diversity Database.	
11	Internal Continuous Assessment: 40%	External, Semester End Examination 60% Individual Passing in Internal and External Examination
12	Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3)	

Title of Paper: S3MJP7: Laboratory exercises based on S3MJ10 – Classification of Chordates

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	This practical course offers hands-on training in the identification, classification, and comparative study of chordates across all major groups. Learners will examine representative species from Cephalochordata, Urochordata, Cyclostomata, fishes, amphibians, reptiles, birds, and mammals using diagnostic morphological characters. The course emphasizes skill-based learning through specimen observations, systematic profiling, and field visits covering aquatic, terrestrial, and volant chordates. Learners document ecological niches, adaptive features, and taxonomic placements while preparing structured field reports.
2	Vertical:	Major
3	Type:	Practical
4	Credit:	2 credits (1 credit = 30 Hours of Practical work in a semester)
5	Hours Allotted:	60 Hours
6	Marks Allotted:	50 Marks

7	Course objectives: • To develop practical skills in identifying and classifying chordates up to representative species level using morphological and phylogenetic characteristics. • To train learners in comparative analysis of chordate adaptations across aquatic, terrestrial, and volant environments. • To enhance field-based learning through systematic observation, documentation, and report writing on chordate biodiversity.
8	Course outcome: On completion of the course the learner will be able to: • Recognize, classify, and differentiate major chordate groups and their representative species based on diagnostic features. • Understand ecological roles and adaptive strategies of chordates in diverse habitats through laboratory and field observations. • Demonstrate proficiency in preparing scientific field reports and applying systematic principles to evaluate chordate diversity.
9	1. Characteristics and Classification of Phylum Chordata A. Subphylum Cephalochordata – <i>Branchiostoma lanceolatum</i> B. Subphylum: Tunicata or Urochordata • Class Ascidiacea – <i>Ascidia ahodori</i>

- Class Thaliacea - *Pegea confoederata*
- Class Larvacea or Appendicularia - *Fritillaria* spp.
- 2. Subphylum: Vertebrata
 - Infraphylum Cyclostomata
 - Class Myxini - *Myxine glutinosa*
 - Class Petromyzontida - *Entosphenus tridentatus*
- 3. Infraphylum Gnathostomata
 - Class Chondrichthyes - *Glyphis gangeticus*
 - Class Osteichthyes - *Epinephelus diacanthus*
- 4. Class Amphibia
 - Class Amphibia
 - Order Anura or Salientia - *Duttaphrynus melanostictus*
 - Order Caudata or Urodela - *Andrias davidianus*
 - Order Gymnophiona or Apoda - *Uraeotyphlus menoni*
- 5. Class Reptilia
 - Order Crocodilia - *Crocodylus palustris*
 - Order Testudines - *Lepidochelys olivacea*
 - Order Squamata - *Ptyas mucosa*
 - Order Rhynchocephali - *Sphenodon guntheri*
- 6. Class Aves
 - Division Palaeognathae - *Dromaius novaehollandiae*
 - Division Neognathae - *Psittacula krameri*, *Phoenicopterus roseus*
- 7. Class Mammalia
 - Subclass Prototheria - *Ornithorhynchus anatinus*
 - Subclass Metatheria - *Vombatus ursinus*
 - Subclass Eutheria - *Rattus rattus*, *Canis aureus*
- 8. Field visit report on aquatic chordates / terrestrial chordates / chordates that fly or glide.

10 References:

1. Noriyuki Satoh (2016). Chordate Origins and Evolution, The Molecular Evolutionary Road to Vertebrates. Academic Press is an imprint of Elsevier, Copyright © 2016 Elsevier Inc. All rights reserved. ISBN: 978-0-12-809934-6 (Print); ISBN: 978-0-12-803006-6 (Online).
2. Lindell Bromham (2016). An Introduction to Molecular Phylogenetics and evolution. Oxford University Press. ISBN 978-0-19-873636-3.
3. Vineeta Rawat (2024). Animal Taxonomy, Behaviour and Chronobiology. ISBN-13: -978 8196080655
4. Eschmeyer's Catalog of Fishes: The website provides monthly updates and addenda to the core family-group names list.
5. FishBase: A comprehensive online information system with data on virtually all fish species, it is a crucial resource for ecologists and fisheries managers. It works in conjunction with the Catalog of Fishes for taxonomic consistency.
6. Integrated Taxonomic Information System (ITIS): A highly comprehensive and authoritative source for the scientific names and classification of species globally. It is widely used as a standard ITIS (.gov).
7. IUCN Red List of Threatened Species: While primarily focused on conservation status, it uses a robust and current taxonomic framework for mammals, birds, reptiles, and amphibians IUCN Red List.
8. The Reptile Database: A continuously updated resource that provides the current taxonomy and geographic data for all known reptile species The Reptile Database.

	9. IOC World Bird List: Maintained by the International Ornithologists' Union, this is a leading reference for the classification and nomenclature of the world's birds IOC World Bird List. 10. Mammal Diversity Database (MDD): Curated by the American Society of Mammalogists, this database reflects the most current understanding of mammal taxonomy ASM Mammal Diversity Database.	
11	Internal Continuous Assessment: 40%	External, Semester End Examination 60% Individual Passing in Internal and External Examination
12	Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3)	

Title of Paper: S3MJ11: Animal Physiology

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	This course provides an integrative understanding of comparative animal physiology, emphasizing on diverse systems and functions across invertebrates and vertebrates. The course illustrates comparative account of digestive, respiratory, circulatory, excretory, nervous, muscular, and sensory systems in animals. The course highlights mechanisms of control and coordination, environmental physiology, and adaptations in varying habitats and stressors. Through comparative analysis, learners will gain insight into physiological specializations such as feeding strategies, gas exchange, osmoregulation, locomotion, behaviour, and temperature regulation to maintain homeostasis and interact with their environment.
2	Vertical:	Major
3	Type:	Theory
4	Credit:	2 credits (1 credit = 15 Hours of Theory in a semester)
5	Hours Allotted:	30 Hours
6	Marks Allotted:	50 Marks
7	Course objectives: The course is designed to acquaint learners to, • The comparative functioning of major organ systems across animal phyla. • The mechanisms of control, coordination, and locomotion in animals. • The physiological adaptations of animals to diverse environmental conditions.	
8	Course outcome: On completion of the course the learner will be able to: • Compare and explain physiological processes in invertebrates and vertebrates. • Develop the ability to relate structure, function, and environment in animal physiology. • Comprehend and apply physiological principles in research, ecology, and applied zoology.	

9	Module 1: Comparative Physiology of Animal Organ Systems	15hrs
	1.1 Digestive Physiology in Animals 1.1.1 Comparative feeding mechanisms in invertebrates & vertebrates 1.1.2 Digestive enzymes in herbivores and carnivores 1.1.3 Gut microbiome – concept and significance	03hrs
	1.2 Respiratory Physiology Across Phyla 1.2.1 Anatomy and physiology: Spiracles and tracheal system, book lungs & book gills, gills, skin and lungs 1.2.2 Respiratory pigments: haemoglobin, haemocyanin, chlorocruorin 1.2.3 Gas exchange efficiency in aquatic and terrestrial habitats	04hrs
	1.3 Circulatory System 1.3.1 Neurogenic and Myogenic hearts 1.3.2 Types of blood vessels – Structure and function 1.3.3 Circulation circuits – Pulmonary and Systemic	04hrs
	1.4 Excretion & Osmoregulation 1.4.1 Comparative study of excretory organs of invertebrates – nephridia (flame cells and metanephridia), Malpighian tubules, coxal glands, renal glands 1.4.2 Comparative study of excretory organs of vertebrates — kidneys, lungs, skin and gills 1.4.3 Osmoregulation in freshwater, estuarine, marine and terrestrial animals	04hrs

	Module 2: Control, Coordination & Homeostasis	15hrs
	2.1 Nervous System in Animals 2.1.1 Nervous systems: Nerve net, ganglia, brain 2.1.2 Comparative study of brain of vertebrates — fish, amphibian, reptile, bird and mammal. 2.1.3 Types of Neurons - Based on Function: Sensory neurons, Motor neurons, Interneurons - Based on Structure: Unipolar neurons, Bipolar neurons, Multipolar neurons - Based on Myelination: Myelinated neurons, Unmyelinated neurons 2.1.4 Neurotransmitters in animals	04hrs
	2.2 Sense organs and behaviour physiology 2.2.1 Sense organs in animals – olfactory, optic, gustatory, tactile, auditory 2.2.2 Types of receptors – Photoreceptors, mechanoreceptors, chemoreceptors, thermoreceptors, nociceptors, magnetoreceptors 2.2.3 Orientation behaviour: taxis and kinesis 2.2.4 Involuntary responses – Reflexes	03hrs
	2.3 Muscle Physiology 2.3.1 Structure and functions of muscles: smooth, striated, cardiac 2.3.2 Muscle contraction mechanism – Sliding filament theory	02hrs
	2.4 Homeostasis and Thermoregulation 2.4.1 Concept of Homeostasis; Acclimation and acclimatization 2.4.2 Body clock - Circadian & Diurnal rhythm 2.4.3 Temperature regulation – ectothermy, endothermy, thermogenesis – shivering and non-shivering mechanisms 2.4.4 Physiological responses to: Daily torpor, hibernation and aestivation 2.4.5 Mechanism of hypoxia tolerance in fish	06hrs

10	References: 1. Choudhary, K. (2025). <i>Animal physiology</i> . IFAS Publications. 2. Arora, M. P. (2017). <i>Animal physiology</i> (7th ed.). Himalaya Publishing House. 3. Singh, H. R., & Kumar, N. (2021). <i>Animal physiology and biochemistry</i> . Vishal Publishing. 4. Hill, R. W., Wyse, G. A., & Anderson, M. (2016). <i>Animal physiology</i> (4th ed.). Oxford University Press. 5. Moyes, C. D., & Schulte, P. M. (2016). <i>Principles of animal physiology</i> (3rd ed.). Pearson Education. 6. Irwin, W. S., & Eddy, F. B. (2012). <i>Environmental physiology of animals</i> (2nd ed.). Wiley-Blackwell. 7. Randall, D., Burggren, W., & French, K. (2002). <i>Eckert animal physiology: Mechanisms and adaptations</i> (5th ed.). W. H. Freeman.	
11	Internal Continuous Assessment: 40%	External, Semester End Examination 60% Individual Passing in Internal and External Examination
12	Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3)	

Title of Paper: S3MJP8: Laboratory exercises based on S3MJ11 – Animal Physiology

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	This practical course provides training in experimental and observational techniques in animal physiology. Learners will perform qualitative biochemical tests, physiological experiments, and comparative anatomical studies to understand organ system functions across invertebrates and vertebrates. The course includes analysis of excretory products, respiratory and locomotory structures, heart and muscle physiology, behavioural responses, and effects of environmental factors.
2	Vertical:	Major
3	Type:	Practical
4	Credit:	2 credits (1 credit = 30 Hours of Practical work in a semester)
5	Hours Allotted:	60 Hours
6	Marks Allotted:	50 Marks
7	Course objectives:	• To develop practical skills in physiological experiments and comparative anatomical studies. • To understand biochemical and functional assessment of organ systems through laboratory tests. • To familiarize learners with applied and diagnostic aspects of physiology.
8	Course outcome: On completion of the course the learner will be able to:	• Perform and interpret basic physiological and biochemical tests. • Identify and compare organ systems, functions and adaptations in animals.
9	1. Qualitative analysis of urine – urea, glucose, albumin, bile, creatinine. 2. Detection of uric acid in bird's excreta. 3. Study of digestive system in animals – earthworm, crab, <i>Sepia</i>, star fish, frog. 4. Study of structure of: T.S. of stomach, T.S. of small intestine — duodenum and ileum, T.S. of liver, T. S. of pancreas (exocrine) in mammals. 5. Study of respiratory structures in animals • Gills of cartilaginous fish • Gills of bony fish • Lungs of frog • Lungs of mammal • Accessory respiratory organ of <i>Anabas</i>, <i>Clarias</i>, <i>Heteropneustes</i>, Mud skipper • Air sacs in pigeon 6. Comparative study of locomotory structures in animals • Invertebrates — muscular feet in <i>Mytilus</i>, parapodia in <i>Nereis</i>, water vascular system in starfish, wings in dragonfly, legs of mud crab. 7. Comparative study of heart structures in invertebrates and vertebrates – earthworm, <i>Octopus</i>, fowl, blue whale. 8. Assessment of Muscle Fatigue using Finger-Tapping Test. 9. Demonstration (only) of oxygen consumption in fish at different temperatures.	

10	References: 1. Choudhary, K. (2025). <i>Animal physiology</i>. IFAS Publications. 2. Arora, M. P. (2017). <i>Animal physiology</i> (7th ed.). Himalaya Publishing House. 3. Singh, H. R., & Kumar, N. (2021). <i>Animal physiology and biochemistry</i>. Vishal Publishing. 4. Hill, R. W., Wyse, G. A., & Anderson, M. (2016). <i>Animal physiology</i> (4th ed.). Oxford University Press. 5. Moyes, C. D., & Schulte, P. M. (2016). <i>Principles of animal physiology</i> (3rd ed.). Pearson Education. 6. Irwin, W. S., & Eddy, F. B. (2012). <i>Environmental physiology of animals</i> (2nd ed.). Wiley-Blackwell. 7. Randall, D., Burggren, W., & French, K. (2002). <i>Eckert animal physiology: Mechanisms and adaptations</i> (5th ed.). W. H. Freeman 8. R. Eckert & D. Randall (1982): "Animal Physiology: 2nd Ed." W. H. Freeman & Co. 9. C. Ladd Prosser Ed. (1991): "Environmental & Metabolic Animal Physiology" "Comparative Animal Physiology" 4th Ed. Wiley — Liss Publ. 10. Withers, P.C. (1983): "Comparative Animal Physiology" International Ed. Saunders College Publishing. 11. K. Schmidt – Niel (1983): "Animal Physiology: Adaptation & Environmental" 3rd Ed. Cambridge Univ. Press.		
11	<table border="1"> <tr> <td data-bbox="167 772 829 884">Internal Continuous Assessment: 40%</td><td data-bbox="829 772 1487 884">External, Semester End Examination 60% Individual Passing in Internal and External Examination</td></tr> </table>	Internal Continuous Assessment: 40%	External, Semester End Examination 60% Individual Passing in Internal and External Examination
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12	<table border="1"> <tr> <td data-bbox="167 884 829 1014"> Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3) </td><td data-bbox="829 884 1487 1014"></td></tr> </table>	Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3)	
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Title of Paper: S3MJ12: Type Study – Cuttlefish (*Sepia*) and Shark (*Scoliodon*)

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	This course provides a comparative study of <i>Sepia</i> (cuttlefish) and Shark (<i>Scoliodon</i>), focusing on their classification, habit and habitat, distribution, and ecological roles. The course provides description of external morphology, locomotion, and economic importance, along with detailed study of major systems, including digestive, respiratory, circulatory, excretory, nervous, sensory, and reproductive structures of cuttlefish and shark.
2	Vertical:	Major
3	Type:	Theory
4	Credit:	2 credits (1 credit = 15 Hours of Theory in a semester)
5	Hours Allotted:	30 Hours
6	Marks Allotted:	50 Marks
7	Course objectives: The course is designed to acquaint learners to, • The habit, habitat, distribution, general characters, and classification of <i>Sepia</i> and Shark. • The structural and functional organization of major systems (digestive, respiratory, circulatory, excretory, nervous, sensory, and reproductive). • The ecological and economic importance of <i>Sepia</i> and Shark, emphasizing their role in marine ecosystems, fisheries, and conservation.	
8	Course outcome: On completion of the course the learner will be able to: • Classify <i>Sepia</i> and Shark within their respective phyla and explain their adaptations to aquatic environments. • Analyze the anatomy and physiology of organ systems in invertebrates (<i>Sepia</i>) and vertebrates (Shark). • Evaluate the ecological significance and economic uses of <i>sepia</i> and shark.	

9	Module 1: Type study – Cuttlefish (<i>Sepia</i>)		15hrs
	1.1 Habit and Habitat, Distribution, General Characters, Classification		06hrs
	1.1.1 Marine distribution and ecological role 1.1.2 General characteristics of Mollusca and Cephalopoda 1.1.3 Taxonomic classification and evolutionary position 1.1.4 External characteristics of <i>Sepia</i>		
	1.2 Systems of <i>Sepia</i>		08hrs
	1.2.1 Digestive system 1.2.2 Respiratory system 1.2.3 Circulatory system 1.2.4 Excretory system 1.2.5 Nervous system and sense organs 1.2.6 Reproductive system		
	1.3 Economic importance of <i>Sepia</i>		01hr
	Module 2: Type study – Shark (<i>Scoliodon</i>)		15hrs

	2.1 Habit and Habitat, Distribution, General Characters, Classification 2.1.1 Marine distribution, migratory patterns and ecological niche 2.1.2 General characteristics of Chondrichthyes 2.1.3 Taxonomic classification and evolutionary position 2.1.4 External characteristics of shark	06hrs
	2.2 Systems of Shark 2.2.1 Digestive system 2.2.2 Respiratory system 2.2.3 Circulatory system 2.2.4 Excretory system 2.2.5 Nervous system and sense organs 2.2.6 Reproductive system	08hrs
	2.3 Economic importance of Shark	01hr

10	References: 1. Agarwal, V. K. (2016). Zoology for Degree Learners: Animal Diversity-I. New Delhi: S. Chand & Company Ltd. 2. Ekambaranatha Ayyar, K. N., & Ananthakrishnan, T. N. (1992). Manual of Zoology: Invertebrates. Madras: S. Viswanathan (Printers & Publishers). 3. Ekambaranatha Ayyar, K. N., & Ananthakrishnan, T. N. (1992). Manual of Zoology: Vertebrates. Madras: S. Viswanathan (Printers & Publishers). 4. Kotpal, R. L. (2012). Modern Textbook of Zoology: Vertebrates. New Delhi: Rastogi Publications. 5. Kotpal, R. L. (2012). Modern Textbook of Zoology: Invertebrates. New Delhi: Rastogi Publications.	
11	Internal Continuous Assessment: 40%	External, Semester End Examination 60% Individual Passing in Internal and External Examination
12	Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3)	

Title of Paper: S3MJP9 Laboratory exercises based on S3MJ12 – Type Study – Cuttlefish (*Sepia*) and Shark (*Scoliodon*)

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	The practical component reinforces theoretical knowledge through hands-on study and dissection. Learners will examine external morphology, dissect digestive and respiratory systems, circulatory structures, and study nervous and sensory organs in both <i>Sepia</i> and Shark. Identification exercises and observations of the specimen are included to develop in the learners the skills for anatomical study, functions and adaptations.
2	Vertical:	Major
3	Type:	Practical
4	Credit:	2 credits (1 credit = 30 Hours of Practical work in a semester)
5	Hours Allotted:	60 Hours
6	Marks Allotted:	50 Marks
7	Course objectives:	- To impart hands-on skills and identification of organ systems in <i>Sepia</i> and <i>Scoliodon</i>. - To acquaint learners the external morphology and organ systems of <i>Sepia</i> and <i>Scoliodon</i>.
8	Course outcome: On completion of the course the learner will be able to:	- Identify and describe the organ systems such as digestive, respiratory, circulatory, nervous, and sensory systems in <i>Sepia</i> and <i>Scoliodon</i>. - Compare and differentiate the morphology and anatomy of <i>Sepia</i> and <i>Scoliodon</i>.
9		- Study of external morphology of <i>Sepia</i> — Observation of body form, tentacles, fins, and cuttlebone. - Study of digestive system in <i>Sepia</i> and associated glands and structures - Study of jaws and radula, chromatophores, spermatophores, and statocyst in <i>Sepia</i>. - Study of nervous system in <i>Sepia</i>. - Study of male and female reproductive system in <i>Sepia</i>. - Study of external morphology of Shark. - Study of placoid scales. - Study of digestive system in Shark. - Study of male and female urinogenital system in Shark. - Study of heart and aortic arches in shark. - Study of endoskeleton of shark: - Axial – Skull and vertebral column (trunk and caudal vertebra). - Appendicular – Pelvic and pectoral fins, pelvic and pectoral girdle.

10	References: 1. Ekambaranatha Ayyar, K. N., & Ananthakrishnan, T. N. (1992). Manual of Zoology: Invertebrates (Practical). Madras: S. Viswanathan (Printers & Publishers). 2. Ekambaranatha Ayyar, K. N., & Ananthakrishnan, T. N. (1992). Manual of Zoology: Vertebrates (Practical). Madras: S. Viswanathan (Printers & Publishers). 3. Kotpal, R. L. (2012). Practical Zoology: Invertebrates. New Delhi: Rastogi Publications. 4. Kotpal, R. L. (2012). Practical Zoology: Vertebrates. New Delhi: Rastogi Publications. 5. Agarwal, V. K. (2016). Practical Zoology for Degree Learners. New Delhi: S. Chand & Company Ltd.	
11	Internal Continuous Assessment: 40%	External, Semester End Examination 60% Individual Passing in Internal and External Examination
12	Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3)	

Title of the Paper: S3MJ13: Histology and Endocrinology

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	This course introduces the fundamental principles of histology and endocrinology. The course covers histology of major organ systems, and staining techniques used in research and diagnostics. The endocrinology component covers hormone types, mechanisms of action, feedback regulation, and disorders of major endocrine glands. Emphasis is placed on integrating structural knowledge with physiological functions and clinical relevance, providing a strong foundation for studies in zoology, biomedical sciences, and health-related fields.
2	Vertical:	Major
3	Type:	Theory
4	Credit:	2 credits (1 credit = 15 Hours of Theory in a semester)
5	Hours Allotted:	30 Hours
6	Marks Allotted:	50 Marks
7	Course objectives: The course is designed to acquaint learners to the, • Microscopic structure, organization, and functions of animal tissues and organ systems. • Principles of endocrine regulation, hormone action, and feedback mechanisms. • Histological techniques and their applications in biomedical research and diagnostics.	
8	Course outcome: On completion of the course the learner will be able to: • Identify and describe the histology of tissues and major organ systems. • Understand endocrine gland functions, hormonal regulation, and associated disorders. • Apply basic histological and endocrinological knowledge to interpret normal and pathological conditions.	

9	Module 1: Histology	15hrs
	1.1 Introduction to Histology 1.1.1 Definition, scope and importance 1.1.2 Animal tissue – Types, structure and their function – epithelial, muscular, connective and nervous. 1.1.2 Relevance in Zoology and diagnostics.	03hrs
	1.2 Histology of Organ Systems 1.2.1 Integumentary System — V.S. of skin (Epidermis, Dermis, Hypodermis) and Associated structures (Hair, Sebaceous and Sweat glands, Skin receptors) 1.2.2 Digestive System — V.S. of Tooth and T.S. of Tongue. General histological organization of the digestive tract: mucosa, submucosa, muscularis externa, and serosa. 1.2.3 Histology of oesophagus, stomach, duodenum, ileum, rectum, and accessory glands — liver, pancreas, and salivary glands	07hrs
	1.3 Staining techniques in histology 1.3.1 Basic concept, principle and applications of special staining techniques: • Haematoxylin-Eosin stain (HE) • PAS staining (Periodic Acid–Schiff) – detection of glycogen • AB staining (Alcian Blue) – detection of acidic mucins • Sudan Black B staining – detection of lipids • Immunohistochemistry (IHC)	06hrs

Module 2: Endocrinology		15hrs
1.1 Introduction to Endocrinology		02hrs
1.1.1 Definition, scope, and importance		
1.1.2 Overview, characteristics of endocrine glands		
1.1.3 Hormones: types, mechanisms (peptide vs steroid)		
1.1.4 Feedback regulation (positive and negative)		
1.2 Hypothalamus, Pituitary Gland and Pineal body		03hrs
1.2.1 Hypothalamic releasing and inhibiting hormones		
1.2.2 Anterior and posterior pituitary – structure and hormones		
1.2.3 Hormones of pineal body		
1.2.4 Disorders: dwarfism, gigantism, acromegaly, diabetes insipidus		
1.3 Thyroid and Parathyroid Glands		03hrs
1.3.1 Structure and hormones (T3, T4, calcitonin, PTH)		
1.3.2 Regulation of calcium metabolism		
1.3.3 Disorders: hyper/hypothyroidism, goitre, tetany		
1.4 Adrenal Gland		02hrs
1.4.1 Adrenal cortex: mineralocorticoids, glucocorticoids, adrenal androgens – DHEA		
1.4.2 Adrenal medulla: adrenaline (epinephrine), nor-adrenaline (nor-epinephrine) and dopamine		
1.4.3 Stress response		
1.4.4 Disorders: Addison's disease, Cushing's syndrome		
1.5 Pancreas and Glucose Homeostasis		02hrs
1.5.1 Islets of Langerhans: cell types – alpha, beta, delta and pp		
1.5.2 Hormones of pancreas – insulin, glucagon, somatostatin, pancreatic polypeptide, amylin.		
1.5.3 Diabetes mellitus		
1.6 Reproductive Endocrinology		02hrs
1.6.1 Gonadal hormones: testosterone, estrogen, progesterone		
1.6.2 Menstrual and estrous cycle regulation		
1.6.3 Hormonal regulation in males		
1.7 Other endocrine organs – Thymus, gastrointestinal tract, heart, placenta, kidneys, adipose tissue		01hr

10	References: 1. Suvarna, S. K., Layton, C., and Bancroft, J. D. (2018). Bancroft's Theory and Practice of Histological Techniques (8th ed.). Elsevier. 2. Junqueira, L. C., and Carneiro, J. (2017). Junqueira's Basic Histology: Text and Atlas (15th ed.). McGraw-Hill. 3. Ross, M. H., and Pawlina, W. (2020). Histology: A Text and Atlas with Correlated Cell and Molecular Biology (8th ed.). Wolters Kluwer. 4. Gartner, L. P., and Hiatt, J. L. (2014). Color Textbook of Histology (4th ed.). Elsevier. 5. Young, B., O'Dowd, G., and Woodford, P. (2014). Wheater's Functional Histology: A Text and Colour Atlas (6th ed.). Elsevier. 6. Nussey, S., and Whitehead, S. (2001). Endocrinology: An integrated approach. BIOS Scientific Publishers. 7. Melmed, S., Polonsky, K. S., Larsen, P. R., Kronenberg, H. M., and Auchus, P. W. (2029). Williams textbook of endocrinology (15th ed.). Elsevier. 8. Wass, J. A. H., Stewart, P. M., Shalet, S. M., and Grossman, A. B. (Eds.). (2022). Oxford textbook of endocrinology and diabetes (3rd ed.). Oxford University Press. 9. Holt, R. I. G., Hanley, N. A., Choudhury, S., and Sonksen, P. H. (2021). Essential endocrinology and diabetes (7th ed.). Wiley-Blackwell. 10. Kleine, B., and Rossmanith, W. G. (2016). Hormones and the endocrine system: Textbook of endocrinology. Springer. 11. Strauss, J. F., III, and Barbieri, R. L. (2019). Yen and Jaffe's reproductive endocrinology: Physiology, pathophysiology, and clinical management (8th ed.). Elsevier. 12. Agarwal, V. K. (2020). Endocrinology. S. Chand Publishing.		
11	<table border="1"> <tr> <td data-bbox="167 929 829 1030">Internal Continuous Assessment: 40%</td><td data-bbox="829 929 1487 1030">External, Semester End Examination 60% Individual Passing in Internal and External Examination</td></tr> </table>	Internal Continuous Assessment: 40%	External, Semester End Examination 60% Individual Passing in Internal and External Examination
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Semester VI Vertical – 1 Electives

Title of the Paper: EL2A Drug development process

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	The course introduces learners to the fundamental aspects of the drug discovery and preclinical development process, including sources of drugs, laboratory screening, and ethical use of animals in research. The course covers process of drug development, regulatory approvals, and modern trends in drug formulation and safety assessment. This course provides an overview of how a drug moves from concept to market, integrating biological, ethical, and regulatory perspectives essential for Zoology learners interested in biomedical and pharmaceutical sciences.
2	Vertical:	Elective
3	Type:	Theory
4	Credit:	2 credits (1 credit = 15 Hours of Theory in a semester)
5	Hours Allotted:	30 Hours
6	Marks Allotted:	50 Marks
7	Course objectives: The course is designed to acquaint learner to, • The concept and significance of the drug development process. • The process of drug discovery, sources, and preclinical testing methods. • Ethical and regulatory aspects of animal testing and clinical trials. • The phases of clinical trials and global regulatory requirements. • The recent advances such as biotechnology and AI in drug development.	
8	Course outcome: On completion of the course the learner will be able to: • Explain the major stages in the drug discovery and development process. • Identify sources and screening methods used in preclinical studies. • Understand ethical guidelines and regulatory frameworks in drug testing. • Describe the design and phases of clinical trials. • Recognize modern trends such as personalized medicine, pharmacovigilance, and AI applications in drug research.	

9	Module 1: Introduction and Preclinical Development	15hrs
	1.1 Introduction to Drug Development	01hr
	1.1.1 Definition and importance	
	1.1.2 Historical background and milestones in drug discovery	
	1.2 Sources of Drugs	02hrs
	1.2.1 Natural sources – plants (Opium, poppy and Cinchona), animals (Insulin from Bovine pancreas and Heparin from Pig), and microorganisms (<i>Penicillium</i> and <i>Streptomyces</i>)	
	1.2.2 Synthetic (Paracetamol) and semi-synthetic (Ampicillin)	
	1.2.3 Biotechnological sources – recombinant products and monoclonal antibodies	
	1.3 Drug Discovery Process	02hrs
	1.3.1 Target identification and validation	
	1.3.2 Lead compound identification and screening	
	1.3.3 Lead optimization and structure – activity relationship (SAR)	

	1.4 Preclinical Studies 1.4.1 <i>In vitro</i> testing – cell and tissue culture studies 1.4.2 <i>In vivo</i> testing — use of animal models (Zebra fish, rats, Cynomolgus monkeys) for pharmacological testing 1.4.3 Pharmacokinetics (ADME)	07hrs
	1.4.4 Pharmacodynamics – mechanism of action and dose–response relationship 1.4.5 Pharmacogenomics and pharmacoeconomics 1.4.6 Toxicity testing – acute, sub-acute, and chronic studies	
	1.5 Screening Methods 1.5.1 Screening for antimicrobial agents 1.5.2 Screening for anti-inflammatory and analgesic agents 1.5.3 Screening for anticancer compounds	03hrs
	Module 2: Clinical Development and Regulatory Process	15hrs
	2.1 Clinical Trials 2.1.1 Overview and objectives of clinical trials 2.1.2 Phases of clinical trials • Phase I – Safety and dosage • Phase II – Efficacy and side effects • Phase III – Large-scale testing and comparison • Phase IV – Post-marketing surveillance 2.1.3 Design of clinical trials and subject selection	04hrs
	2.2 Ethics in Clinical Research 2.2.1 Importance of ethics in human experimentation 2.2.2 Informed consent – process and essential components 2.2.3 Institutional Ethics Committees (IEC) – composition and role 2.2.4 Institutional Review Board (IRB) – Roles and responsibilities	02hrs
	2.3. Regulatory Aspects 2.3.1 National and international regulatory authorities • CDSCO (India) • US-FDA (United States) • EMA (Europe) • WHO (Global standards) 2.3.2 Steps in the drug approval process in India	02hrs
	2.4 Drug Formulation and Evaluation 2.4.1 Types of dosage forms 2.4.2 Evaluation of formulations for stability and bioavailability 2.4.3 Quality control and assurance parameters	03hrs
	2.5 Post-marketing Surveillance 2.5.1 Adverse Drug Reactions (ADR) – definition and classification 2.5.2 Pharmacovigilance – objectives, methods, and importance 2.5.3 Long-term drug safety monitoring	02hrs
	2.6 Recent Trends 2.6.1 Personalized medicine and genetic profiling in treatment 2.6.2 Biotechnology applications – recombinant proteins and monoclonal antibodies 2.6.3 Artificial Intelligence (AI) and computational tools in drug discovery	02hrs

10	References: 1. Rang, H.P., Dale, M.M., Ritter, J.M., Flower, R.J., and Henderson, G. (2019). Rang and Dale's Pharmacology, 9th Edition, Elsevier Health Sciences. pp. 1–20, 783–801. 2. Tripathi, K.D. (2018). Essentials of Medical Pharmacology, 8th Edition, Jaypee Brothers Medical Publishers, New Delhi. pp. 1–33, 931–940. 3. Patrick, G.L. (2017). An Introduction to Medicinal Chemistry, 6th Edition, Oxford University Press. pp. 1–120, 571–598. 1. Rawlins, E.A. and Cumming, J.H. (2002). Bentley's Textbook of Pharmaceutics, 8th Edition, Baillière Tindall (Elsevier). pp. 1–80, 700–760.		
	2. Vogel, H.G. (2008). Drug Discovery and Evaluation: Pharmacological Assays, 3rd Edition, Springer-Verlag, Berlin Heidelberg. pp. 3–95, 263–295. 3. ICH Harmonised Guideline (2019). Good Clinical Practice (E6 R2), International Council for Harmonisation. pp. 5–42. 4. CDSCO (2023). Schedule Y: Requirements and Guidelines for Clinical Trials, Government of India. pp. 1–27. 5. CPCSEA (2023). Guidelines for Laboratory Animal Facility, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India. pp. 8–32. 6. Katzung, B.G., Vanderah, T.W., and Trevor, A.J. (2021). Basic and Clinical Pharmacology, 15th Edition, McGraw Hill Education. pp. 1–23, 79–96.		
11	<table border="1"> <tr> <td data-bbox="167 947 831 1048">Internal Continuous Assessment: 40%</td><td data-bbox="831 947 1487 1048">External, Semester End Examination 60% Individual Passing in Internal and External Examination</td></tr> </table>	Internal Continuous Assessment: 40%	External, Semester End Examination 60% Individual Passing in Internal and External Examination
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Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3)			

Title of Paper: ELP2A Laboratory exercises based on EL2A Drug development process

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	The practical course introduces learners to the laboratory techniques and methods involved in drug development. Learners will perform estimations of common drugs, study dose-response relationships, and understand animal models and dosage forms. The course also includes a field/industrial visit to a pharmaceutical or herbal drug facility to observe formulation and quality control processes.
2	Vertical:	Major
3	Type:	Practical
4	Credit:	2 credits (1 credit = 30 Hours of Practical work in a semester)
5	Hours Allotted:	60 Hours
6	Marks Allotted:	50 Marks
7	Course objectives: The course is designed to acquaint learner to, • Skills in drug estimation and extraction. • Identify common dosage forms and animal models used in drug testing. • The pharmaceutical industry operations and quality control.	
8	Course outcome: On completion of the course the learner will be able to: • Perform quantitative estimation of commonly used drugs. • Identify common dosage forms and animal models.	
9	1. Estimation of Ibuprofen in Tablets (Back titration). 2. Estimation of Paracetamol in Tablets (Colorimetric – Folin-Ciocalteu / FeCl_3). 3. Estimation of Caffeine in Beverages (Colorimetric – Folin C). 4. Estimation of Antacid Tablets (Acid neutralization titration). 5. Estimation of Aspirin in Tablets (Hydrolysis and Colorimetric – FeCl_3). 6. Identification of Common Dosage Forms – Tablets, Capsules, Syrups, Ointments, Injections, Powders. 7. Identification of Animal Models for Drug Testing – Albino Mice, Wistar Rats, NZW Rabbits, Cavy Guinea pigs, Zebrafish. 8. Industrial / Field Visit (Observation of pharmaceutical/herbal drug formulation and QC processes) / Virtual field visit.	
10	References: 1. C.K. Kokate, Purohit, Gokhale, Practical Pharmacognosy, Nirali Prakashan, 4th Edition, 2017. 2. G.H. Jeffery, J. Bassett, J. Mendham, R.C. Denney, Vogel's Textbook of Quantitative Chemical Analysis, Pearson / Prentice Hall, 5th/6th Edition. 3. R. Ananthanarayan, C.K. Jayaram Paniker, Pharmaceutical Microbiology Practical Manual, Universities Press, 9th Edition. 4. P.N.S. Chatterjee, S. Bhattacharya, Pharmacology Practical Manual, Academic Publishers, Latest Edition. 5. R.K. Goyal, G.P. Sharma, Laboratory Manual of Pharmacology, Jaypee Brothers, Latest Edition. 6. William P. Janzen, Handbook of Drug Screening Methods, CRC Press, 2006.	
11	Internal Continuous Assessment: 40%	External, Semester End Examination 60% Individual Passing in Internal and External Examination
12	Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3)	

Title of the Paper: EL2B Wildlife management

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	This course provides a comprehensive knowledge of principles and advanced conservation strategies, integrating ecological theories for Wildlife Management. It introduces the scope and history of wildlife management, habitat and species management techniques, population monitoring methods, wildlife health, forensics, and governance frameworks. The course illustrates the modern tools such as telemetry, GIS, remote sensing, modeling, and conservation genomics to address contemporary challenges including climate change, human-wildlife conflict, and biodiversity loss. Emphasis is also given on community participation, legal frameworks, eco-development, and future-oriented approaches to prepare learners for research, conservation practice, and policy-oriented careers.
2	Vertical:	Major
3	Type:	Theory
4	Credit:	2 credits (1 credit = 15 Hours of Theory in a semester)
5	Hours Allotted:	30 Hours
6	Marks Allotted:	50 Marks
7	Course objectives:	- To develop a strong conceptual foundation in wildlife ecology, management principles, and conservation biology. - To acquaint learners with traditional and modern tools used in wildlife monitoring, health assessment, and management planning. - To augment in learners the understanding of human dimensions, legal frameworks, and community-based approaches in wildlife conservation.
8	Course outcome: On completion of the course the learner will be able to:	- Explain wildlife management concepts, population dynamics, and habitat management strategies. - Apply analytical tools such as census methods, GIS-based approaches, and basic modeling to wildlife conservation problems. - Critically evaluate conservation policies, human-wildlife conflict mitigation strategies, and emerging challenges in wildlife management.

9	Module 1: Foundations of Wildlife Management	15hrs
	1.1 Principles and Scope 1.1.1 Definition and importance of wildlife 1.1.2 History, scope and objectives of Wildlife Management 1.1.3 Threats to Wildlife	02hrs
	1.2 Habitat and Species Management 1.2.1 Habitat management techniques: plantations, shelters, nesting places, waterholes, salt licks, controlled burning 1.2.2 Prey-predator dynamics and trophic cascades (Tiger-Deer-Vegetation)	03hrs
	1.3 Wildlife Population Studies, Census and Enumeration Methods: 1.3.1 Direct (transects, camera traps, point counts) 1.3.2 Indirect (tracks, scats, call counts, dung counts)	03hrs
	1.4 Health and Forensics in Wildlife 1.4.1 Wildlife health and disease management	03hrs

	1.4.2 Wildlife forensics: Identification of skins, bones, feathers 1.4.3 DNA barcoding	
	1.5 Human Dimensions and Governance 1.5.1 Human-wildlife conflicts: causes, consequences, and mitigation strategies 1.5.2 Wildlife laws and policies: Wildlife Protection Act 1972 and its amendments, CITES, TRAFFIC, CBD (1992), Red Data Book, BDA (2002), Article 48A, and Article 51A(g)	03hrs
	1.6 Community and Institutional Roles 1.6.1 Traditional ecological knowledge and community participation 1.6.2 Role of NGOs and Institutions	01hrs
	Module 2: Advanced Wildlife Management Strategies	15hrs
	2.1 Conservation Approaches 2.1.1 In-situ (NP, WLS, BR) and ex-situ conservation (zoos, gene banks, captive breeding) Translocations, reintroductions, and rewilding 2.1.2 Wildlife corridors (elephant, tiger and leopard corridors) and landscape connectivity	03hrs
	2.2 Monitoring and Analytical Tools 2.2.1 Telemetry (VHF, GPS, satellite), tagging, microchips, ethical considerations, GIS, remote sensing, drones 2.2.2 Modelling in wildlife management: Population Viability Analysis (PVA), Species Distribution Models (SDMs)	03hrs
	2.3 Contemporary Challenges 2.3.1 Climate change impacts: range shifts, species vulnerability 2.3.2 Emerging threats: invasive species, wildlife trade, hybridization, genetic bottlenecks	03hrs
	2.4 Human Dimensions and Eco-Development 2.4.1 Eco-development and eco-tourism: sustainable models, CSR 2.4.2 Human dimensions toolkit: socio-economic survey design, conflict documentation, ethics in fieldwork 2.4.3 Biomimetics and ecosystem services valuation (TEEB framework)	03hrs
	2.5 Global and Future Perspectives 2.5.1 International conventions: Ramsar, IUCN protected area categories 2.5.2 Future of wildlife management: conservation genomics, AI in monitoring, eDNA, smart collars 2.5.3 Integration through capstone mini-projects (wildlife census, HWC mapping, corridor design, eco-tourism planning)	03hrs

10	References: 1. Caughley, G. & Sinclair, A.R.E. (1994). Wildlife Ecology and Management. Blackwell Science. 2. Bookhout, T.A. (1996). Research and Management Techniques for Wildlife and Habitats. The Wildlife Society, Washington D.C. 3. Prater, S.H. (2005). The Book of Indian Animals. Bombay Natural History Society. 4. Giles, R.H. Jr. (1978). Wildlife Management Techniques. The Wildlife Society. 5. E.P. Odum & G.W. Barrett (2020). Fundamentals of Ecology. Cengage Learning. 6. Rodgers, W.A. & Panwar, H.S. (1988). Planning a Wildlife Protected Area Network in India. Wildlife Institute of India. 7. Negi, S.S. (1995). Biodiversity and Its Conservation in India. Indus Publishing Company. 8. Singh, S. & Sharma, S. (2022). Wildlife Forensics and Conservation Biology. Springer. 9. Karanth, K.U. & Nichols, J.D. (2017). Methods for Monitoring Tiger and Prey Populations. Springer. 10. Rangarajan, M. (2001). India's Wildlife History: An Introduction. Permanent Black. 11. Mishra, C. & Redpath, S. (2011). Human-Wildlife Conflicts: Conservation Challenges and Opportunities. Cambridge University Press.
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11	Internal Continuous Assessment: 40%	External, Semester End Examination 60% Individual Passing in Internal and External Examination
12	Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3)	

Title of Paper: ELP2B Laboratory exercises based on EL2B Wildlife management

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	This practical course provides training in wildlife management techniques, integrating laboratory analysis with field-based applications. Learners will gain knowledge on species identification, population estimation methods, diversity analysis, bioacoustics, telemetry, camera trapping, and GIS-based wildlife mapping. Field exercises emphasize transect surveys, bird counts, behavioral observations, GPS handling, and identification of wildlife signs. The course includes assessment of human-wildlife conflict and protected area visit to acquaint learners with real-world management challenges. The course strengthens analytical, observational, and reporting skills, preparing learners for field research, conservation practice, and advanced studies in wildlife biology and management.
2	Vertical:	Elective
3	Type:	Practical
4	Credit:	2 credits (1 credit = 30 Hours of Practical work in a semester)
5	Hours Allotted:	60 Hours
6	Marks Allotted:	50 Marks
7	Course objectives:	- To train learners in laboratory and field techniques used for wildlife identification, monitoring, and population assessment. - To impart skills in data analysis, mapping, and interpretation of wildlife-related datasets. - To acquaint learners with practical conservation challenges and management practices through field exposure.
8	Course outcome: On completion of the course the learner will be able to:	- Identify wildlife species, signs, and biological materials using laboratory and field methods. - Apply standard techniques for population estimation, diversity analysis, and spatial mapping in wildlife studies. - Demonstrate the ability to document, analyze, and report field observations relevant to wildlife management and conservation.
9		- Identification of animal skulls (tiger, jackal, bear, deer, rodent, elephant) and hide (tiger, leopard, bear, nilgai, lion, crocodile) using photographs / models / ICT tools. - Preparation and analysis of plaster casts of pugmarks and hoof marks. - Preparation and analysis of pugmarks and hoof marks using tracing glass and tracing paper. - Line transect sampling for animal sightings (suitable animal); make a short report on the same. - Calculation of diversity indices from sample wildlife datasets. - Simpson's Diversity Index - Shannon-Wiener Index - Pielou's Evenness Index - Study of wildlife tracking and telemetry devices (camera trap, antennas, transmitters, microchips, tranquilizing equipment). - Study of animal behaviour (e.g., foraging, social, territorial) on basis of films / videos / field visits; make a report on the same. BORIS or suitable software may be used. - Case studies on human-wildlife conflict in India (Human-Elephant conflict, Human-Leopard conflict, Human-Tiger conflict, Human-Crocodile conflict, Monkey menace, Bear menace, Wolf menace, Snake menace or suitable example – any two to be taken during practicals and one case study report; apart from those taken during practical should be submitted during external exam).

9. Field Visit to a Protected Area (National Park / Sanctuary/ Biosphere Reserve) for exposure to management practices and prepare a report on it.
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10	References:
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| 1. Bookhout, T.A. (1996). Research and Management Techniques for Wildlife and Habitats. The Wildlife Society, Washington D.C. |
| 2. Giles, R.H. Jr. (1978). Wildlife Management Techniques. The Wildlife Society. |
| 3. Sutherland, W.J. (2006). Ecological Census Techniques: A Handbook. Cambridge University Press. |
| 4. Prater, S.H. (2005). The Book of Indian Animals. Bombay Natural History Society. |
| 5. Karanth, K.U. & Nichols, J.D. (2017). Methods for Monitoring Tiger and Prey Populations. Springer. |
| 6. Rodgers, W.A. & Panwar, H.S. (1988). Planning a Wildlife Protected Area Network in India. Wildlife Institute of India. |
| 7. Singh, S. & Sharma, S. (2022). Wildlife Forensics and Conservation Biology. Springer. |
| 8. Mishra, C. & Redpath, S. (2011). Human-Wildlife Conflicts: Conservation Challenges and Opportunities. Cambridge University Press. |
| 9. Krebs, C.J. (2014). Ecology: The Experimental Analysis of Distribution and Abundance. Pearson. |
| 10. Rangarajan, M. (2001). India's Wildlife History: An Introduction. Permanent Black. |

11	Internal Continuous Assessment: 40%
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External, Semester End Examination 60% Individual Passing in Internal and External Examination

12	Continuous Evaluation through:
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Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3)
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Title of the Paper: EL2C Fishery Biology

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	This course is designed to acquaint learners to the various fishery technology, fishing methods, and sustainable fisheries management with emphasis on Indian marine and freshwater resources. It covers navigational and safety equipment, oceanographic sampling instruments, fishing crafts, gears, engines, and modern technologies such as SONAR, GPS, and drones. The course also covers fish processing, quality assessment, nutrition, feed technology, fisheries economics, and conservation.
2	Vertical:	Major Elective
3	Type:	Theory
4	Credit:	2 credits (1 credit = 15 Hours of Theory in a semester)
5	Hours Allotted:	30 Hours
6	Marks Allotted:	50 Marks
7	Course objectives:	- To acquaint learners to the fishing crafts, gears, navigation systems, and oceanographic instruments used in fisheries. - To develop in learners an understanding of fishery resources of India, post-harvest technology, nutrition, and feed formulation. - To acquaint learners about sustainable fisheries, climate change impacts, and conservation-oriented fisheries management practices.
8	Course outcome: On completion of the course the learner will be able to:	- Identify major Indian fish and shellfish species, fishing gears, fishery technology and its applications. - Comprehend fish quality assessment, nutritional value, feed technology, and post-harvest management. - Apply the concepts of sustainability, climate adaptation, and conservation in fisheries and aquaculture practices.

9	Module 1: Fishery Technology, Oceanography and Fishing Methods	15hrs
	1.1 Introduction to Fishery Biology & Fisheries	03hrs
	1.1.1 Definition, scope, and significance of fishery biology and fisheries 1.1.2 Classification of fishery resources: freshwater, marine, brackish water 1.1.3 Types of fisheries: Capture fisheries, culture fisheries, artisanal, commercial, inland, marine 1.1.4 Economic, nutritional, ecological, and socio-cultural importance of fisheries	
	1.2 Navigational, Sea Safety and Observation Tools	03hrs
	1.2.1 Life-saving devices aboard fishing vessels: life boat, life jackets, life raft, life buoy, TPA, MES 1.2.2 Emergency signalling devices: flares, whistle, strobe lights 1.2.3 Modern navigation tools: GPS, echo sounder, radar, All-in-one weather station	
	1.3 Oceanographic and Sampling Instruments	04hrs
	1.3.1 Water and sediment sampling tools: Niskin water sampler, Peterson's grab, Ekman's grab, dredges 1.3.2 Fish detection devices: Fish finder, SONAR, acoustic tags, LIDAR, drones in fisheries monitoring 1.3.3 Application of remote sensing and satellite imagery for potential fishing zones (PFZ)	
	1.4 Crafts, Gears and Engine Technology	03hrs

	1.4.1 Boat building basics: parts, designs and materials of used for building boats, winch and deck equipment layout, anti-fouling treatment 1.4.2 Engine types: outboard and inboard; 2-stroke and 4-stroke diesel engines 1.4.3 Fishing gear operations: gill nets, trawl nets, purse seine, hooks-and-line, fishing Jigs 1.4.4 Innovations in fishing gear design to reduce by-catch and habitat damage	
	1.5 Climate Change and Fisheries 1.5.1 Impact of climate change on fisheries 1.5.2 Role of Indian fisheries in climate adaptation: early warning systems, diversification of livelihoods	02hrs
	Module 2: Fisheries, Processing, Nutrition, Economics and Conservation	15hrs
	2.1 Common Fishes of India: Catch and Fishery 2.1.1 Marine Fishes: Sardine, Mackerel, Pomfret, Indian Anchovy, Seer fish. 2.1.2 Freshwater Fishes: Rohu, Catla, Mrigal, Tilapia, Murrel. 2.1.3 Estuarine fishes: Barramundi, Hilsa, Mullet, Milk fish	05hrs
	2.2 Common Shellfishes of India: Catch and Fishery 2.2.1 Shrimps / Prawns: Tiger prawn (<i>Penaeus monodon</i>), Indian white shrimp (<i>Penaeus indicus</i>) 2.2.2 Crabs: Mud crab (<i>Scylla serrata</i>), swimming crabs (<i>Portunus sp</i>) 2.2.3 Molluscs: Green mussel (<i>Perna viridis</i>), oyster (<i>Saccostrea cucullata</i>), squid (<i>Uroteuthis duvaucelii</i>) and cuttlefish (<i>Sepia pharaonis</i>)	04hrs
	2.3 Fish Quality, Standards and Sustainable Development 2.3.1 Spoilage and biochemical changes: hyperaemia, rigor mortis, autolysis, lipid oxidation / rancidity 2.3.2 Freshness/quality evaluation: organoleptic, microbial, and chemical methods 2.3.3 Sanitation standards: Hygiene of surfaces, equipment; water / ice quality; effluent treatment in processing plants 2.3.4 Eco-friendly aquaculture practices: biofloc, integrated aquaculture, aquaponics	03hrs
	2.4 Fish as a Source of Nutraceuticals 2.4.1 Fish oil 2.4.2 Fish collagen and gelatin 2.4.3 Chitosan 2.4.4 Nutritional products from fishes	03hrs

10	References: 1. Bal, D.V. and Rao, K.V. (2004). Marine Fisheries of India. Tata McGraw Hill. 2. Jhingran, V.G. (2011). Fish and Fisheries of India. Hindustan Publishing. 3. Lagler, K.F., Bardach, J.E., Miller, R.R. and Passino, D.R. (2007). Ichthyology. John Wiley and Sons. 4. Gupta, S.K. and Gupta, P.C. (2013). General and Applied Ichthyology. S. Chand and Co. 5. Pillay, T.V.R. and Kutty, M.N. (2005). Aquaculture: Principles and Practices. Blackwell. 6. FAO (2018). The State of World Fisheries and Aquaculture. FAO, Rome. 7. Kurien, J. and Nagasaki, R. (2016). Fisheries Co-management in India. FAO. 8. Natarajan, P. - Fishery Science and Technology. 9. Gopakumar, K. - Fish Processing Technology and Product Development.	
11	Internal Continuous Assessment: 40%	External, Semester End Examination 60% Individual Passing in Internal and External Examination
12	Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3)	

Title of the Paper: ELP2C Laboratory exercises based on EL2C Fishery Biology

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	This practical course provides experiential learning in fisheries technology, marine biology, and fishery-related operations. Learner will gain knowledge on navigational and safety equipment, oceanographic sampling tools, fishing gears, engines, and deck machinery. The course emphasizes identification of economically important marine, estuarine, freshwater fishes and shellfishes, along with sustainable fishing practices and gear modifications. Practical training also includes basic microbial techniques, preparation of fish feed using local resources, and field visits to fisheries-related facilities such as fish markets, processing plants, or cold storage units. The course integrates technology, sustainability, and applied skills relevant to fisheries and aquaculture sectors.
2	Vertical:	Major
3	Type:	Practical
4	Credit:	2 credits (1 credit = 30 Hours of Practical work in a semester)
5	Hours Allotted:	60 Hours
6	Marks Allotted:	50 Marks
7	Course objectives:	• To familiarize learner with fisheries equipment, fishing gears, and basic oceanographic sampling tools. • To develop skills in fish and shellfish identification, microbial techniques, and feed preparation. • To acquaint learners to sustainable fisheries practices.
8	Course outcome: On completion of the course the learner will be able to:	• Identify and operate basic fisheries equipment, gears, and safety devices. • Demonstrate proficiency in identifying fishery resources and preparing simple fish feeds. • Understand sustainable fisheries concepts.
9	1. Navigational and safety equipment: GPS, life jackets, lifebuoys, rudders, steering systems, signaling devices. 2. Oceanographic sampling instruments: Niskin water sampler, Petersen Grab, Ekman's grab, toothed dredge, scallop dredge. 3. Engine types: outboard, inboard, 2-stroke, 4-stroke diesel. 4. Identification and operation of fishing gears: gill nets, otter trawl, purse seines, hook-and-line, fishing jigs. 5. Identification and fisheries of common marine fishes: Mackerel, Pomfret, Indian Anchovy, Cobia, Seer fish. 6. Identification and fisheries of common freshwater fishes: Rohu, Catla, Mrigal, Magur, Murrel. 7. Identification and fisheries of common shellfishes: Green mussel (<i>Perna viridis</i>), oyster (<i>Saccostrea cucullata</i>), squid (<i>Uroteuthis duvaucelii</i>) and cuttlefish (<i>Sepia pharaonis</i>), Mud crab (<i>Scylla serrata</i>), swimming crabs (<i>Portunus sp.</i>), Tiger prawn (<i>Penaeus monodon</i>), Indian white shrimp (<i>Penaeus indicus</i>). 8. Identification and fisheries of common estuarine fishes: Hilsa, Barramundi, Mullet, Milk fish. 9. Study of sustainable gear designs: Turtle Excluder Devices, eco-friendly trawls. 10. Determination of freshness of fish / shellfish using organoleptic methods. 11. Microbial examination of fish / shellfish samples (Demonstration only). 12. Field visit to fish processing plant, cold storage, or local fish market and submission of report.	

10	References: 1. Balachandran, K.K. (2001). Post-Harvest Technology of Fish and Fish Products. Daya Publishing. 2. Gopakumar, K. (2002). Textbook of Fish Processing Technology. ICAR-CIFE. 3. Panda, S.K. (2017). Fishery Technology. Narendra Publishing House. 4. Jhingran, V.G. (2011). Fish and Fisheries of India. Hindustan Publishing. 5. Srivastava, C.B.L. (2008). Fishery Science and Technology. Kitab Mahal. 6. FAO Manuals on Fisheries Technology and Aquaculture Practices. 7. Pillay, T.V.R. (2004). Aquaculture: Principles and Practices. Blackwell.	
11	Internal Continuous Assessment: 40%	External, Semester End Examination 60% Individual Passing in Internal and External Examination
12	Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3)	

Title of Paper: EL2D Clinical research

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	This course provides a comprehensive introduction to clinical research and clinical trials, covering the journey from discovery to market. Learners will be acquainted with the fundamentals of medical diagnostics, clinical trial design, phases, and operational workflows. Emphasis is placed on ethical principles, regulatory frameworks, and stakeholder roles in India and globally. The course introduces clinical data management, basic biostatistics, safety monitoring, and adverse event reporting. Learners also gain exposure to scientific writing, trial documentation, compliance requirements, and emerging models such as virtual and decentralized trials. The program prepares learners for entry-level roles and career pathways in clinical research, pharmaceuticals, and academia.
2	Vertical:	Major
3	Type:	Theory
4	Credit:	2 credits (1 credit = 15 Hours of Theory in a semester)
5	Hours Allotted:	30 Hours
6	Marks Allotted:	50 Marks
7	Course objectives:	- To build foundational knowledge of clinical research principles, ethical frameworks, regulatory guidelines, and the role of stakeholders in clinical trial processes. - To develop a practical understanding of clinical trial design, clinical operations, drug safety monitoring, clinical data management, and scientific communication. - To prepare learners for professional roles in clinical research by imparting applied skills in documentation, compliance, and career development pathways.
8	Course outcome: On completion of the course the learner will be able to:	- Explain the basic clinical research process, trial phases, ethical principles, and regulatory framework and requirements in the global and Indian context. - Apply knowledge of clinical trial design, clinical data management, adverse event reporting/analysis, and scientific writing to simulated or real-world clinical research scenarios. - Demonstrate professional competencies in documentation, compliance, communication, and career preparedness for roles in CROs, pharma/biotech/vaccine/MedTech, or academic research.

9	Module 1: Foundations of Clinical Research	15hrs
	1.1 Basics of Clinical Research 1.1.1 Definition and concepts 1.1.2 Evolution (Global and India) 1.1.3 Importance in healthcare, drug development and public health 1.1.4 Growth, challenges, initiatives	02hrs
	1.2 Overview of Clinical Research Process and Stakeholders 1.2.1 From discovery to market 1.2.2 Stakeholders: Sponsors (Innovators), CROs, ECs, Drug Safety, Regulators, Investigators	02hrs
	1.3 Clinical Trial Design and Phases 1.3.1 Observational vs Interventional 1.3.2 Trial phases (Pre-clinical to Phase IV) 1.3.3 Study design concepts (randomization, blinding, controls, crossover, parallel)	04hrs

1.3.4	Intro to virtual / decentralized clinical trials	
1.4 Ethics and Regulatory Guidelines		03 hrs
1.4.1	Core ethical principles, informed consent	
1.4.2	Confidentiality and data privacy (GDPR, HIPAA)	
1.4.3	National and international guidelines (ICMR, GCP, Schedule Y, Helsinki) Regulatory frameworks (ICH-GCP, CDSCO, DCGI, USFDA, EMA)	
1.5 Roles and Responsibilities in Clinical Research		04hrs
1.5.1	PI, CRC, CRA, Data, Analysis, Writer roles	
1.5.2	Role of participants and team conduct	
1.5.3	Medical Terminology and Documentation	
1.5.4	Trial docs, GDP, ALCOA+ basics	
Module 2: Clinical Data Management and Reporting		15hrs
2.1 Clinical Data Management, Biostatistics and Statistical Programming		04hrs
2.1.1	Data sources, eDC basics	
2.1.2	Introduction to statistics (central tendencies: mean, mode and median; t-test; Chi-square test; ANOVA) and visualization [R, Statistical Analysis System (SAS)]	
2.2 Safety Monitoring and Adverse Event Reporting		03hrs
2.2.1	AE / SAE concepts and classifications	
2.2.2	Reporting timelines and Vigilance basics (Pharmacovigilance, Cosmetovigilance, Meterio-vigilance and Neutra-vigilance)	
2.3 Communication and Scientific Writing		04hrs
2.3.1	Clinical Study Reports, abstracts, posters	
2.3.2	Registries (CTRI, ClinicalTrials.gov)	
2.3.3	Communicating with regulators, patients, public	
2.4 Advanced Documentation and Compliance		02hrs
2.4.1	Source data verification, audit trails	
2.4.2	21 CFR Part 11, data integrity	
2.5 Professional Development and Careers		02hrs
2.5.1	Required certifications, conflict of interest	
2.5.2	Career pathways in CR (CROs, Pharma, Academia)	
2.5.3	Knowledge Process Outsourcing (KPO) for clinical research	

10	References:	
	1. Principles and Practice of Clinical Research - John I. Gallin, Frederick P. Ognibene, Laura Lee Johnson.	
	2. Fundamentals of Clinical Trials - Lawrence M. Friedman, Curt D. Furberg, David L. DeMets.	
	3. Design and Analysis of Clinical Trials: Concepts and Methodologies - Shein-Chung Chow, Jen-Pei Liu.	
	4. Practical Guide to Clinical Data Management - Susanne Prokscha.	
	5. Fundamentals of Biostatistics - Bernard Rosner.	
	6. Pharmacovigilance: Principles and Practice - Ronald D. Mann, Elizabeth B. Andrews.	
	7. ClinicalTrials.gov - Database of global clinical trials.	
	8. WHO International Clinical Trials Registry Platform (ICTRP).	
	9. CTRI (Clinical Trials Registry of India).	
	10. TransCelerate BioPharma - Resources on clinical trial efficiencies and innovation.	
	11. Society for Clinical Data Management (SCDM) - Data management and digital transformation best practices.	
	12. DIA (Drug Information Association) - Training modules and regulatory updates.	
11	Internal Continuous Assessment: 40%	External, Semester End Examination 60% Individual Passing in Internal and External Examination
12	Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3)	

Title of Paper: ELP2D Laboratory exercises based on EL2D Clinical research

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	This practical course provides hands-on training in clinical research operations and regulatory practices. Learners engage in protocol review, informed consent form drafting, and ethical dilemma discussions to understand trial conduct. Simulated trial management exercises cover feasibility assessment, delegation logs, documentation, and handling protocol deviations. Learners gain exposure to electronic data capture systems, data entry, cleaning, query resolution, and basic biostatistical analysis using mock datasets. Practical sessions include adverse event reporting with MedDRA coding, audit and inspection role-plays, and industry visits to CROs and clinical operations units, bridging theoretical knowledge with real-world clinical research practice.
2	Vertical:	Major
3	Type:	Practical
4	Credit:	2 credits (1 credit = 30 Hours of Practical work in a semester)
5	Hours Allotted:	60 Hours
6	Marks Allotted:	50 Marks
7	Course objectives:	- To provide practical exposure to clinical trial processes, including protocol interpretation, documentation, data management, and safety reporting. - To develop applied skills in ethical compliance, trial monitoring, and interaction with clinical research stakeholders (CROs, pharma units, ethics committees).
8	Course outcome: On completion of the course the learner will be able to:	- Demonstrate competence in drafting, managing, and interpreting essential clinical trial documents (protocols, ICFs, CRFs, TMFs) and using digital trial tools (EDC systems). - Analyze trial-related scenarios (protocol deviations, AE/SAE cases, audits) and apply corrective actions in alignment with regulatory and ethical standards.
9	- Protocol review and interpretation. - ICF drafting and ethical dilemma discussion. - Trial management simulation (delegation logs, feasibility checklist). - Document drafting (CRF, Source Doc, TMF checklist). - Examples: protocol deviations and corrective actions. - EDC system overview (REDCap/OpenClinica). - Data management workshop: entry, cleaning, queries. - Biostatistics workshop (mock dataset analysis) - Calculate the mean, mode, median, and standard deviation. - AE/SAE reporting simulation (forms and MedDRA coding). - Audit and inspection role-play. - Industry Visit - CRO / Ethics Committee interaction (protocol and ICF process) / Industry Visit – Pharma / CRO Clinical Operations Unit (data, safety, reporting).	

10	References: 1. Principles and Practice of Clinical Research - John I. Gallin, Frederick P. Ognibene, Laura Lee Johnson. 2. Fundamentals of Clinical Trials - Lawrence M. Friedman, Curt D. Furberg, David L. DeMets. 3. Design and Analysis of Clinical Trials: Concepts and Methodologies - Shein-Chung Chow, Jen-Pei Liu. 4. Practical Guide to Clinical Data Management - Susanne Prokscha. 5. Fundamentals of Biostatistics - Bernard Rosner. 6. Pharmacovigilance: Principles and Practice - Ronald D. Mann, Elizabeth B. Andrews. 7. ClinicalTrials.gov - Database of global clinical trials. 8. WHO International Clinical Trials Registry Platform (ICTRP). 9. CTRI (Clinical Trials Registry of India). 10. TransCelerate BioPharma - Resources on clinical trial efficiencies and innovation. 11. Society for Clinical Data Management (SCDM) - Data management and digital transformation best practices. 12. DIA (Drug Information Association) - Training modules and regulatory updates.		
11	<table border="1"> <tr> <td data-bbox="167 629 831 730">Internal Continuous Assessment: 40%</td><td data-bbox="831 629 1487 730">External, Semester End Examination 60% Individual Passing in Internal and External Examination</td></tr> </table>	Internal Continuous Assessment: 40%	External, Semester End Examination 60% Individual Passing in Internal and External Examination
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12	<table border="1"> <tr> <td data-bbox="167 730 831 862"> Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3) </td><td data-bbox="831 730 1487 862"></td></tr> </table>	Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3)	
Continuous Evaluation through: Quizzes / Class Tests / Presentation / Project / Role play / Creative writing / Assignment etc. (at least 3)			

QUESTION PAPER PATTERN (External and Internal)

T. Y. B. Sc. Zoology evaluation pattern and question paper pattern for semester end theory examination of Major course.

Internal Continuous Assessment: 40% (20 Marks)	Semester End Examination: 60% (30 Marks)	Duration for End Semester Examination
Continuous Evaluation through: Quizzes, Class Tests, Presentation, Project, Role play, Creative writing, Assignment, etc. (at least 3)	As per paper pattern	01:00 hour

Format of Theory Question Paper: Semester End Examination

T. Y. B. Sc. NEP Question Paper Pattern External Theory (Major, Minor,

Electives) Credits – 2

Time 1 hr

Max. Marks 30

NB:			
1. All Questions are compulsory.			
2. Draw neat and labelled diagram wherever necessary.			
Q. No.	Type	Marks	Module
Q .1	Multiple choice question / Fill in the blanks (Any 5 out of 10) (5 from each module)	5	1 & 2
Q .2	Answer in 1-2 sentences (Any 5 out of 10) (5 from each module)	5	1 & 2
Q 3	Answer any 2 of the following (Any 2 out of 4)	10	1
Q 4.	Answer any 2 of the following (Any 2 out of 4)	10	2

T. Y. B. Sc. Zoology Evaluation pattern and Question paper pattern for Semester End Practical Examination of Major Course

Internal Continuous Assessment: 40% (20 Marks)	Semester End Examination: 60% (30 Marks)	Duration for End Semester Examination
Continuous Evaluation through: Quizzes, Class Tests, Presentation, Project, Role play, Creative writing, Assignment, etc. (at least 3)	As per paper pattern	02:30 hours

Format of Question Paper: (Separately specified for courses on laboratory exercises and VSC)

N.B:

- I) It is pertinent to note that we have to adhere strictly to the directions as given in the UGC Circular F14-4/2006 (CPP-II).
- II) Apart from the Institutional Animal Ethics Committee (IAEC) and any other Committee appointed by a Competent Authority / Body from time to time, every college should constitute the following Committees:
 - 1) A Committee for the Purpose of Care and Supervision of Experimental Animals (CPCSEA) and
 - 2) A Dissection Monitoring Committee (DMC) to ensure that no unauthorized and non-essential dissections are done.

Composition of DMC shall be as follows:

- i) Head of the Concerned Department (Convener / Chairperson)
- ii) Two Senior Faculty Members of the concerned Department
- iii) One Faculty of related department from the same College
- iv) One or two members of related department from neighbouring colleges.

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Skeleton Question Paper pattern for Practical Examination Semester – V

S3MJP5: Laboratory exercises based on S3MJ7 – Classification of Non-Chordates

Duration: 2:30 hrs

Total Marks: 30

- | | |
|--|----|
| Q.1 Identify, classify and describe:
d) Protista / Porifera
e) Cnidaria / Minor Phyla | 04 |
| Q.2 Identify, classify and describe:
a) Platyhelminthes / Nematoda / Annelida
Platyhelminthes / Nematoda / Annelida
Note: Phyla must be different for 'a' and 'b' | 04 |
| Q.3 Identify, classify giving reasons:
a) Arthropoda
b) Mollusca
c) Echinodermata | 06 |
| Q.4 Identify classify up to class giving reasons: Specimen not studied in syllabus. | 02 |
| Q.5 Certified Field Visit Report (only Non-chordates) and viva based on it. | 10 |
| Q.6 Certified Journal. | 04 |

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Skeleton Question Paper pattern for Practical Examination

Semester – V

S3MJP6: Laboratory exercises based on S3MJ8 – Haematology and Immunology

Duration: 2:30 hrs

Total Marks: 30

Q.1 **Major Experiment:** Perform any **ONE** allotted experiment from the following: 10

- Enumeration of Erythrocytes - Total Count
- Enumeration of Leucocytes - Total Count
- Determination of serum LDH using colorimeter / spectrophotometer
- Estimation of total serum / plasma proteins by Folin's method
- Estimation of serum / plasma total triglycerides by Phosphovanillin method
- Estimation of Blood Glucose by GOD-POD method
- Differential count of Leucocytes

Q.2 **Major Experiment:** Perform any **ONE** allotted experiment from the following: 08

- Determination of bleeding time and clotting time
- Latex agglutination test - Rheumatoid Arthritis
- Haemagglutination test - Blood grouping (ABO & Rh)
- Interpretation of Complete Blood Count (CBC) report including modern tests
- Estimation of calcium from blood serum by O-Cresolphthalein Complexone (OCPC) method
- Estimation of haemoglobin by Sahli's acid haematin method

Q.3 Identify and describe: 06

- a) Bone marrow / Thymus
- b) Lymph node / Spleen
- c) Tonsil / Peyer's patches

Q.4 Certified Journal and Viva based on Haematology and Immunology. 06

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Skeleton Question Paper pattern for Practical Examination Semester – V

ELP1A Laboratory exercises based on EL1A Zoogeography and Zoopharmacognosy

Duration: 2:30 hrs

Total Marks: 30

- | | |
|--|----|
| Q.1 Mark the Zoogeographic Realm / region on the map and describe its fauna:
Palearctic Realm / Nearctic Realm / Neotropical Realm / Afrotropical (formerly Ethiopian) Realm / Indomalayan or Oriental Realm / Australian Realm / Oceanian Realm / Saharo-Arabian Realm / Panamanian Realm / Sino-Japanese Realm / Madagascan (Malagasy) Realm / Antarctic Conservation Biogeographic Regions (ACBRs) | 04 |
| Q.2 Identify and describe
a) Any one animal of Palearctic Realm
b) Nearctic Realm
c) Neotropical Realm
d) Afrotropical (formerly Ethiopian) Realm | 06 |
| Q.3 Identify and describe:
a) Indomalayan or Oriental Realm
b) Australian Realm
c) Oceanian Realm
d) Saharo-Arabian Realm | 06 |
| Q.4 Identify and describe:
a) Panamanian Realm
b) Sino-Japanese Realm
c) Madagascan (Malagasy) Realm
d) Antarctic Conservation Biogeographic Regions (ACBRs) | 06 |
| Q.5 Identify and describe with respect to zoopharmacognosy:
a) Elephant / deer / lamb / bird
b) Bear / cat / dog | 04 |
| Q.6 Certified Journal. | 04 |

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Skeleton Question Paper pattern for Practical Examination Semester – V

ELP1B Laboratory exercises based on EL1B Medical Diagnostics

Duration: 2:30 hrs

Total Marks: 30

Major Experiment

Q.1 To measure blood glucose using glucometer.

07

OR

To perform the test for Dengue/ Malaria using rapid tests kit method.

OR

To perform qualitative test for glucose in urine.

Minor Experiment

Q.2 To measure the blood pressure using digital machine / Sphygmomanometers.

05

OR

To measure the temperature using clinical /digital thermometers.

OR

Interpretation of the given ECG / CBC / blood biochemistry / urine routine report.

OR

To measure the oxygen saturation using pulse oximeter.

Q.3 Identify and describe:

08

a) Based on the interpretation of blood smear: malaria / sickle cell anaemia

b) Based on identification of instrument: CT scan / MRI / PET scan

c) Based on identification of instrument: Portable ultrasound / Bioanalyzers / Handheld X-ray device

d) Based on identification of instrument: Automatic cell counters / Nebulizer

Q.4 Certified Report submission and viva based on NABH / NABL - accredited lab or hospital /suitable diagnostic centre.

04

Q.5 Certified Journal and Viva based on Medical Diagnostics.

06

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Skeleton Question Paper pattern for Practical Examination Semester – V

ELP1C Laboratory exercises based on EL1C Marine Science

Duration: 2:30 hrs

Total Marks: 30

- | | |
|---|----|
| Q.1 Estimate nitrates / organic carbon from seawater. | 06 |
| Q.2 Estimate phosphates / silicates / nitrites from seawater. | 04 |
| OR | |
| Calculate marine litter abundance and beach quality indices. | |
| Q.3 Identify and describe:
a) Intertidal organisms (any one)
b) Intertidal organisms (any one)
c) Sea weed (any one) | 06 |
| Q.4 Identify and describe:
a) Zooplankton (any one)
b) Marine fish (any one)
c) Marine fish (any one) | 06 |
| Q.5 Field visit report. | 04 |
| Q.6 Certified Journal | 04 |

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Skeleton Question Paper pattern for Practical Examination Semester – V

VSC4a Aquaculture

Duration: 2:30 hrs

Total Marks: 30

Q.1 Demonstrate of hardness / alkalinity / ammonia / nitrate / phosphates and conductivity from the given water sample. 06

Q.2 Determination of soil texture and pH from given sample. 04

OR

Calculate Feed Conversion Ratio (FCR), Food Efficiency Ratio (FER) and Protein Efficiency Ratio (PER) from the data provided.

Q.3 Identify and describe: 04

- a) Cages / rafts / pens / raceways / dykes / nets / aerators / pumps / feed dispensers
- b) Secchi disk / pH meter / DO meter

Q.4 Identify and describe: 04

- a) *Chlorella* / *Scenedesmus* / *Navicula* / *Spirulina* / Rotifers / Cladocerans / Copepods
- b) Catla / Rohu / Mrigal / Silver carp / Grass carp / Common carp / Catfish / Sea bass / Mullet / Freshwater prawn / Tiger prawn / Mud crab

Q.5 Identify and describe: 04

- a) Edwardsiellosis / Streptococcosis / Aeromoniasis / Infectious Pancreatic Necrosis / Viral Hemorrhagic Septicemia
- b) White Spot Syndrome Virus / Fusariosis / Cladosporiosis / Gill fluke infection / Lepeophtheirus infection / Capillariasis

Q.6 a) Field visit report (4m). 06
b) Feasibility report (2m).

Q.7 Certified Journal. 02

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Skeleton Question Paper pattern for Practical Examination Semester – V VSC4b Sericulture

Time: 2:30 Hours

Total Marks: 30

- Q.1 Major Experiment** 04
- A. Describe and illustrate the life cycle of the given silk worm (Mulberry or Tassar).
OR
- A. Describe and illustrate the digestive system and silk glands of the silkworm larva. 04
- B. Demonstrate the processing of cocoons by performing stifling, boiling, and reeling. 06
- Q.2 Minor Experiment**
- A. Demonstrate the feeding as per the instars of the silkworm in a laboratory setup. 05
OR
- A. Construct/Prepare a daily feeding time table chart, specifying feeding frequency. 05
- B. Identify the larval stage and comment on the feeding time and feeding quantity. 03
OR
- B. Demonstrate the hatching of silkworm eggs in the laboratory setup and submit a report. 03
- Q.3 Identification** 04
- a) Identify and describe the given silk moth variety
b) Identify the given host plant specimen or photograph/silkworm rearing appliances.
c) Identify the given pest/predator specimen and suggest one control measure.
d) Identify the given diseased silkworm sample/Photograph and suggest a management practice.
- Q.4** A. Submission of business plan/feasibility report based on Sericulture. 02
B. Submission of sericulture unit visit report. 02
- Q.5** Certified Journal & Viva voce. 04

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Skeleton Question Paper pattern for Practical Examination

Semester – V

VSC4c Environmental Audit

Duration: 2:30 hrs

Total Marks: 30

Q.1 Data-Based* Practical Exercise:

10

- Analyse two-year electricity usage data and prepare an interpretive report with energy-saving recommendations.

OR

- Analyse the provided air-quality data and interpret with suggested interventions in a report format.

OR

- Estimate carbon footprint using the given dataset.

Q.2 Identify and describe:

08

a) and b): Any two devices from water consumption / water measurement / water management

c) and d): Any two of Coloured bins for waste segregation from solid waste / e-waste / hazardous waste / biomedical waste

Q.3 Interpretation of given case study / audit report and viva based on it. (Examiner can ask for **ANY ONE** of the following)

08

- Lighting audit
- Survey plant/ animal diversity in the campus or suitable area
- Noise pollution mapping
- Environmental compliance report
- Water conservation practices survey

Q.4 Certified Journal.

04

*Learners will be provided with datasets / secondary data. Prepare a brief analytical report with tables/graphs, interpretation and recommendations.

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Skeleton Question Paper pattern for Practical Examination Semester – VI

S3MJP7: Laboratory exercises based on S3MJ10 – Classification of Chordates

Duration: 2:30 hrs

Total Marks: 30

- | | |
|--|----|
| Q.1 Identify, classify and describe:
a) Urochordata/ Cephalochordata
b) Cyclostomata
c) Osteichthyes / Chondrichthyes | 06 |
| Q.2 Identify, classify giving reasons:
a) Amphibia
b) Reptilia
c) Aves
d) Mammalia | 08 |
| Q.3 Identify classify up to class giving reasons: Specimen not studied in syllabus (only Vertebrates). | 02 |
| Q.4 Certified Field Visit Report (only Chordates) and viva based on it. | 10 |
| Q.5 Certified Journal. | 04 |

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Skeleton Question Paper pattern for Practical Examination Semester – VI

S3MJP8: Laboratory exercises based on S3MJ11 – Animal Physiology

Duration: 2:30 hrs

Total Marks: 30

- Q.1 Study of qualitative analysis of urine: Urea / glucose / albumin / Bile / creatinine (Any four) 08
- Q.2 Assessment of muscle fatigue using the Finger-Tapping Test. 06
OR
Detection of uric acid in bird's excreta.
- Q.3 Identify and describe: 06
- a) Locomotory Structures: Muscular foot in *Mytilus* / Parapodia in *Nereis* / Water vascular system in starfish / Wings in dragonfly / Legs of mud crab
 - b) Heart Structures: Heart of earthworm / Heart of Octopus / Heart of fowl / Heart of blue whale
 - c) Study of Mammalian tissues: T.S. of stomach / T.S. of small intestine (duodenum / ileum) / T.S. of liver / T.S. of pancreas (exocrine)
- Q.4 Identify and describe: 06
- a) Study of the digestive system: earthworm / crab / Sepia / starfish / frog
 - b) Study of respiratory structures in animals: Gills of cartilaginous fish / Gills of bony fish / Lungs of frog / Lungs of mammal /
 - c) Accessory respiratory organs (*Anabas* / *Clarias* / *Heteropneustes* / Mud skipper) / Air sacs in pigeon
- Q.5 Certified Journal. 04

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Skeleton Question Paper pattern for Practical Examination Semester – VI

S3MJP9 Laboratory exercises based on S3MJ12 – Type Study – Cuttlefish (*Sepia*) and Shark (*Scoliodon*)

Duration: 2:30 hrs

Total Marks: 30

- Q.1 Draw and describe the digestive system of *Sepia*. 06
OR
Draw and describe the digestive system of Shark.
- Q.2 Draw and describe the male / female reproductive system / nervous system of *Sepia*. 10
OR
Draw and describe male / female urinogenital system / heart and aortic arches of Shark.
- Q.3 Identify and describe: 08
a) Chromatophores / spermatophores of *Sepia*
b) Jaw and radula / Statocyst of *Sepia* / placoid scale of shark.
c) Axial skeleton of Shark: Skull / trunk / caudal vertebra
d) Appendicular skeleton of Shark: Pelvic fins / pectoral fins / pelvic girdle / pectoral girdle.
- Q.4 Certified Journal and viva based on Type Study - Cuttlefish (*Sepia*) and Shark (*Scoliodon*) 06

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Skeleton Question Paper pattern for Practical Examination Semester – VI

ELP2A Laboratory exercises based on EL2A Drug Development Process

Duration: 2:30 hrs

Total Marks: 30

- | | |
|---|----|
| Q.1 Major Experiment | 10 |
| Estimation of Ibuprofen in tablets by back titration. | |
| OR | |
| Estimation of Paracetamol in tablets using colorimetric method. | |
| OR | |
| Estimation of Caffeine in beverages using colorimetric method. | |
| OR | |
| Estimation of Aspirin in tablets using colorimetric method. | |
| Q.2 Minor Experiment | 08 |
| Estimation of Antacid tablets by acid neutralization titration. | |
| Q.3 Identify and describe | 04 |
| a) Dosage Forms: Tablets / Capsules / Syrups / Ointments / Injections / Powders | |
| b) Animal Models for Drug Testing: Albino Mice / Wister Rats / NZW Rabbits / Cavy Guinea pigs / Zebrafish | |
| Q.4 Industrial / Field Visit Report and viva based on it. | 06 |
| Q.5 Certified Journal. | 04 |

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Skeleton Question Paper pattern for Practical Examination Semester – VI

ELP2B Laboratory exercises based on EL2B Wildlife management

Duration: 2:30 hrs

Total Marks: 30

- | | |
|---|----|
| Q.1 Identify: | 05 |
| a) animal skull | |
| b) hide | |
| c), d) & e) Wildlife tracking and telemetry devices. | |
| Q.2 Preparation and analysis of plaster casts / tracing glass and tracing paper of pugmarks and hoof marks. | 03 |
| Q.3 Demonstration of line transect method. Calculation of diversity indices from sample wildlife datasets: Simpson's Diversity Index / Shannon-Wiener Index / Pielou's Evenness Index | 05 |
| Q.4 Submission of report on recording of animal behaviour. | 04 |
| Q.5 Submission of report on case study on wildlife conflict. | 04 |
| Q.6 Report on field visit to a protected area. | 05 |
| Q.7 Certified journal and viva based on wildlife management. | 04 |

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Skeleton Question Paper pattern for Practical Examination Semester – VI

ELP2C Laboratory exercises based on EL2C Fishery Biology

Duration: 2:30 hrs

Total Marks: 30

- | | | |
|-----|---|----|
| Q.1 | Determination of freshness of fish / shellfish using organoleptic methods. | 04 |
| Q.2 | Identify and describe:
a) GPS / life jackets / lifebuoys / rudders / steering systems / signalling devices
b) Niskin water sampler/ grabs / dredges
c) Outboard/inboard engines / 2-stroke / 4-stroke diesel engine / Turtle Excluder Devices / eco-friendly trawls | 06 |
| Q.3 | Identify and describe fishing gear: gill nets / otter trawl / purse seines / hook-and-line / fishing jigs | 02 |
| Q.4 | Identify and describe fisheries of:
a) Mackerel / Pomfret / Indian Anchovy / Cobia / Seer fish
b) Rohu / Catla / Mrigal / Magur / Murrel
c) Hilsa / Barramundi / Mullet / Milk fish | 06 |
| Q.5 | Identify and describe fisheries of:
a) Green mussel (<i>Perna viridis</i>) / oyster (<i>Saccostrea cucullata</i>) / squid (<i>Uroteuthis duvaucelii</i>) / cuttlefish (<i>Sepia pharaonis</i>)
b) Mud crab (<i>Scylla serrata</i>) / swimming crabs (<i>Portunus sp.</i>) / Tiger prawn (<i>Penaeus monodon</i>) / Indian white shrimp (<i>Penaeus indicus</i>) | 04 |
| Q.6 | Submission of field visit report and viva based on it. | 06 |
| Q.7 | Certified Journal. | 02 |

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Skeleton Question Paper pattern for Practical Examination Semester – VI

ELP2D Laboratory exercises based on EL2D Clinical research

Duration: 2:30 hrs

Total Marks: 30

Major

- Q.1 You are given a clinical trial protocol extract for a Phase II oncology study. Identify three key elements (objective, eligibility criteria, and endpoint) and explain how they influence study design and patient recruitment. 07

OR

Draft the essential sections of an Informed Consent Form (ICF) for a diabetes clinical trial. How would you address an ethical dilemma if the trial involves illiterate participants?

OR

Prepare a Delegation of Authority Log for a trial site team. What factors should be considered when assessing site feasibility before trial initiation?

Minor

- Q.2 Draft a sample Case Report Form (CRF) for capturing baseline demographic details. Also list the essential documents that must be maintained in the Trial Master File (TMF). 05

OR

A patient missed a scheduled visit in a cardiovascular trial, leading to a missed lab assessment. Classify this event as a protocol deviation or violation. Suggest two corrective and preventive actions (CAPA).

OR

Explain how Electronic Data Capture (EDC) systems (e.g., OpenClinica/REDCap) improve trial efficiency compared to paper CRFs. Mention two challenges faced during EDC implementation.

- Q.3 Describe: 08

- a) You are provided with raw trial data containing errors and missing values. Explain the process of data cleaning and how queries are generated and resolved in a clinical trial.

OR

A patient reports nausea and vomiting after taking an investigational drug. Another patient is hospitalized for severe liver toxicity. Classify each event as AE, SAE, or SUSAR, and explain the reporting timelines as per ICH-GCP and CDSCO.

- b) A mock dataset from a hypertension trial is given. Calculate the mean, mode, median, and standard deviation for systolic blood pressure. Interpret what these values indicate about the patient population.

OR

Imagine you are part of a trial site undergoing a regulatory inspection. Prepare a checklist of five key documents the inspector is likely to request. How should the site staff respond to common audit findings?

- Q.4 Report and viva based on CRO visit (Virtual / In person). 06

- Q.5 Certified Journal 04

Vertical – 6

Name of Faculty: Science & Technology Name

of Programme: B.Sc. (Zoology)

Duration: 30 hrs (Field Work+ Survey) + 15hrs (Discussion + Report Writing): Total - 45 hrs

Indicative Topics for CEP

Sr. No.	Name of the Topic
1	Mapping and mitigation of mosquito breeding sites in local area.
2	Apiculture (beekeeping) as an income-generating opportunity for local farmers.
3	Water quality monitoring and awareness on biodiversity of local pond/river.
4	Citizen science project: documenting urban birds and installing feeders/nest boxes.
5	Turning biodegradable waste into fertilizer: promoting vermicomposting in residential colonies.
6	Snake bite prevention and understanding local snake behaviour in agricultural areas.
7	Invasive species awareness.
8	Urban bird conservation awareness drive.
9	Wildlife rescue helpline promotion in communities.
10	Responsible pet ownership campaign.
11	Street dog population control and sterilization awareness.
12	Bird window-collision prevention drive.
13	Water bowls for birds in summer.
14	Microplastic awareness through aquatic fauna study.
15	Pigeon population and respiratory health awareness.
16	Spiders as free pest controllers in homes.
17	Light pollution impact survey: saving the night ecology.
18	Awareness about air quality index in relation to health.
19	Fly diversity as sanitation indicators.
20	Pet obesity and lifestyle survey.
21	Butterfly garden creation in schools and parks.
22	Plastic ingestion in urban animals.
23	Awareness about proper sleep and its impact on health.
24	Wetland biodiversity documentation drive.
25	Rescue and first aid awareness for injured birds.

The topics are indicative and the faculty members should allot Community Engagement Project that are relevant and important as per core Subject. The Community Engagement Project may be taken individual or in a group up to 5 learners with proper guidance from Faculty.

Evaluation Pattern:

Evaluation during CEP Program involves two key components:

External Evaluation 60%

Internal Evaluation 40%

Evaluation Chart

(i) External Evaluation (Marks 30)

Criteria	Marks
Objectives, Literature Review, Methodology, Data Analysis, Conclusion and Recommendations	15
Overall Project Report Structure and Style	5
Presentation Skills & Communication	10
Total	30

(ii) Internal Evaluation by Guide (Marks 20)

Criteria	Marks
Attendance, Community interactions completion and interaction with Supervisor	10
Overall Report quality	10
Total	20

EXAMINATION PATTERN FOR MAJOR/OE/IKS/VEC

- **Continuous Internal Assessment (20 Marks):**

Sr. No.	Particulars	Marks
1	One Assignment.	10
2	Departmental Activity	05
3	Overall conduct as a responsible learner, mannerism and articulation and exhibit of leadership qualities in organizing related academic activities	05
	Total	20

Semester End Examination (30 Marks):**Question Paper Pattern**

1. These examinations shall be of **One Hour** duration. Maximum marks 30.
2. There shall be Three questions each of **10 marks**. Questions 1 will be based on **Unit-I**, **Questions 2** will be based on **Unit-II**. Question 3 will be based on Unit III
3. All questions shall be compulsory with internal choice within the questions. (Each question will be of **10 marks** with

options.)

4. Question may be subdivided into sub-questions A, B, C the allocation of marks depends on the weightage of the topic.

Distribution of external 60 marks

Qn.	Sub-Qn	Particulars	Unit	Marks with options	Total Marks for qn
1	A,B,C	Answer the following (Attempt any one out of three)	I	30	10
2	A,B,C	Answer the following (Attempt any one out of three)	II	30	10
3	A,B,C	Answer the following (Attempt one out of three)	III	30	10
		Total		90	30